# Chronic Diseases in Canada

Volume 31 · Number 2 · March 2011

## Inside this issue


49 **A profile of older community-dwelling home care clients with heart failure in Ontario**
*A. D. Foebel, J. P. Hirdes, G. A. Heckman, S. L. Tyas, E. Y. Tjam*

58 **The effectiveness of implementing a reminder system into routine clinical practice: does it increase postpartum screening in women with gestational diabetes?**
*A. K. Shea, B. R. Shah, H. D. Clark, J. Malcolm, M. Walker, A. Karovitch, E. J. Keely*

65 **The development of community health indicators: a district-wide approach**
*M. W. Russell, L. A. Campbell, S. Kisely, D. Persaud*

71 **Projection of future cancer incidence and new cancer cases in Manitoba, 2006–2025**
*J. Nowatzki, B. Moller, A. Demers*

79 **Dietary sodium intake among Canadian adults with and without hypertension**
*Y. Shi, M. de Groh, H. Morrison, C. Robinson, L. Vardy*

88 **CSEB Student Conference 2010 abstract winners**


Public Health Agency of Canada
Agence de la santé publique du Canada

Canada

**Chronic Diseases in Canada**
a publication of the Public Health Agency of Canada

CDIC Editorial Board

Howard Morrison, PhD
Editor-in-Chief
(613) 941-1286

Robert A. Spasoff, MD
Associate Scientific Editor

Claire Infante-Rivard, MD
Associate Scientific Editor

Elizabeth Kristjansson, PhD
Associate Scientific Editor

Michelle Tracy, MA
Managing Editor

Lesley Doering, MSW
Public Health Agency of Canada

Robert Geneau, PhD
Public Health Agency of Canada

Isra Levy, MB, FRCPC, FACPM
Ottawa Public Health

Lesli Mitchell, MA
Centers for Disease Control and Prevention

Scott Patten, MD, PhD, FRCPC
University of Calgary

Barry Pless, CM, MD, FRCPC
Montreal Children's Hospital

Kerry Robinson, PhD
Public Health Agency of Canada

Fabiola Tatone-Tokuda, MSc
University of Ottawa

Andreas T. Wielgosz, MD, PhD, FRCPC
Public Health Agency of Canada

Don Wigle, MD, PhD
University of Ottawa

Russell Wilkins, MUrb
Statistics Canada

Chronic Diseases in Canada (CDIC) is a quarterly scientific journal focussing on current evidence relevant to the control and prevention of chronic (i.e. non-communicable) diseases and injuries in Canada. Since 1980 the journal has published a unique blend of peer-reviewed feature articles by authors from the public and private sectors and which may include research from such fields as epidemiology, public/community health, biostatistics, the behavioural sciences, and health services or economics. Only feature articles are peer reviewed. Authors retain responsibility for the content of their articles; the opinions expressed are not necessarily those of the CDIC editorial committee nor of the Public Health Agency of Canada.

Chronic Diseases in Canada
Public Health Agency of Canada
785 Carling Avenue
Address Locator 6805B
Ottawa, Ontario K1A 0K9

Fax: (613) 941-9502
E-mail: cdic-mcc@phac-aspc.gc.ca

Indexed in Index Medicus/MEDLINE, SciSearch® and Journal Citation Reports/ Science Edition

MIX
Paper from responsible sources
FSC® C103200

To promote and protect the health of Canadians through leadership, partnership, innovation and action in public health.
— Public Health Agency of Canada

Published by authority of the Minister of Health.
© Her Majesty the Queen in Right of Canada, represented by the Minister of Health, 2010
ISSN 0228-8699

This publication is also available online at www.publichealth.gc.ca/cdic
Également disponible en français sous le titre : *Maladies chroniques au Canada*

# A profile of older community-dwelling home care clients with heart failure in Ontario

*A. D. Foebel, MSc (1); J. P. Hirdes, PhD (1,2); G. A. Heckman, MD, MSc (1,3); S. L. Tyas, PhD (1,4); E. Y. Tjam, PhD (1,5)*

## Abstract

**Introduction**: The aging of the Canadian population is associated with a rising burden of heart failure (HF), a condition associated with significant morbidity, mortality and health service use.

**Methods**: We used data from the Ontario Resident Assessment Instrument-Home Care database for all long-stay home care clients aged 65 years or older to (1) describe the demographic and clinical characteristics of home care clients with HF and (2) examine service use among home care clients with HF to promote management at home with appropriate services.

**Results**: Compared with other home care clients, HF clients exhibit more health instability, take more medications, experience more comorbid conditions and receive significantly more nursing, homemaking and meal services. They are hospitalized more frequently, have significantly more emergency department visits and use more emergent care.

**Discussion**: HF clients are a more complex group than home care clients in general. Patient self-care must be tailored to the clinical characteristics, patterns of service use and barriers to self-care of the client. This is particularly true for older, frail and medically complex HF patients, many of whom require home care services. This work provides a background upon which to base initiatives to help these higher-needs clients manage their HF at home with appropriate support and services.

***Keywords:*** *heart failure, chronic disease, home care, interRAI, disease management, self-care, Ontario Resident Assessment Instrument-Home Care, older adults.*

## Introduction

Heart failure (HF) is a "complex syndrome in which abnormal heart function results in, or increases the subsequent risk of, clinical symptoms and signs of low cardiac output and/or pulmonary or systemic congestion."[1] An estimated 500 000 Canadians live with HF [2] and its prevalence increases with age.[3] At age 80, both men and women have approximately a 20% lifetime risk of developing HF.[3] Population aging and improved survival of patients with hypertension and myocardial infarction, two important risk factors for HF, contribute to the rising prevalence of HF.[4,5]

Already a substantial burden on the Canadian health care system, projections of the future burden of HF are worrisome: HF incidence is projected to double in Canada by 2025 due to population aging, with the most rapid growth in prevalence expected in those over 85 years old.[6,7]

Despite advances in the overall treatment and management of HF, survival and quality of life remain poor; in Canada, 4430 deaths were attributable to HF in 2004.[8] HF is associated with annual mortality rates as high as 50%, and 25% to 40% of patients will die within one year of diagnosis.[1,9] HF patients today are primarily 65 years or older and suffer from multiple comorbidities including hypertension, diabetes, arthritis, cognitive impairment and depression.[10,11]

The prevalence of HF translates into high costs for the Canadian health care system. The repeated hospitalizations, complex treatment regimen and cost of pharmacotherapy strain many components of health care including primary and specialty care, emergency departments (ED) and hospitals.[12] Among Canadians over 85 years of age, HF is responsible for more hospitalizations than ischemic heart disease or heart attack.[8] Readmission rates for disease complications can reach 33% within three to six months;[13] patients with HF are re-admitted because of poor clinical status, which may continue to worsen in hospital. Hospitalization itself, in fact, appears to lead to progressive functional decline and eventual placement into a long-term care (LTC) facility;[14-16] over 10% of hospitalizations of older adults resulting in an Alternate Level of Care designation are for cardiovascular disease, particularly HF, as are up to 20% of transfers of LTC residents to hospital.[17,18] LTC residents hospitalized with HF may experience long ED waits and spend on average six days in hospital.[18] Further, 7.4% of LTC residents hospitalized for HF remain in hospital as Alternate Level of Care patients awaiting transfer back to their LTC home.[18] Such admissions are often unsuitable and potentially preventable if HF were better managed in primary care.[19-23] Specifically, the health care system

Author references:

1. Department of Health Studies and Gerontology, University of Waterloo, Waterloo, Ontario, Canada
2. Homewood Research Institute, Guelph, Ontario, Canada
3. Department of Medicine, Division of Geriatrics McMaster University, Hamilton, Ontario, Canada
4. Department of Psychology, University of Waterloo, Waterloo, Ontario, Canada
5. St. Mary's General Hospital, Kitchener, Ontario, Canada

**Correspondence:** Andrea Foebel, Department of Health Studies and Gerontology, University of Waterloo, 200 University Ave. West, Waterloo, Ontario, Canada N2L 3G1;
Tel.: (519) 888-4567 ext. 37859; Fax: (519) 746-4657;
Email: adfoebel@mailservices.uwaterloo.ca

needs new approaches for the management of HF targeted towards reducing the risk and duration of hospitalizations.[7]

Effective management of HF is challenging as it involves complex pharmacotherapeutic regimens, periodic adjustment of medication doses, elaborate dietary and fluid intake regimens, exercise therapy, and ongoing patient education to ensure appropriate self-care. The Canadian Heart Health Strategy and Action Plan recommends the Chronic Disease Management (CDM) model as the preferred model for care delivery for cardiovascular disease.[24] A fundamental characteristic of CDM is patient-centered emphasis on disease self-care, which incorporates both self-maintenance and self-management. Self-maintenance requires adherence to prescribed treatments and health practices,[25] while self-management builds on self-maintenance and includes recognition of signs and symptoms of HF, evaluation of the importance of these signs and symptoms, implementation of a treatment option and evaluation of the treatment chosen.[25,26] Self-management requires learning skills, insight, judgment, problem-solving and decision-making, and is more cognitively demanding than self-maintenance. CDM programs targeting HF strive to promote patient self-care; they have been shown to improve quality of life and functional status, reduce unplanned and repeated hospitalizations, and possibly reduce mortality.[27,28] However, HF in older patients is often associated with multiple medical comorbidities and polypharmacy, as well as with depression and cognitive impairment, all of which can interfere with self-care and prevent patients from fully benefitting from CDM programs.[29,30] Further, there is no clear understanding of the ideal duration of such programs or the most effective mode of follow-up.[28,31]

Given the high prevalence of HF in populations over 65 years old, the acute health care system needs enhanced CDM for HF to ease the burden on itself. Working in partnership with primary care physicians and specialty HF clinics, home care is a potentially important component of CDM for HF and may also provide a means of follow-up beyond the initial program.[32] Developing methodologies to assess levels of risk, identify barriers to self-care, and deliver specific community-based interventions to home care clients with HF would make a significant contribution to an overall CDM strategy for HF.

HF is a common disease, but there is little research on the demographic and clinical characteristics, service use and needs of these clients in home care. This study seeks to (1) describe the demographic and clinical characteristics of long-stay home care clients with HF and (2) examine service use among long-stay home care clients with HF to promote management at home with appropriate services.

## Methods

### *Data Source*

We retrieved demographic, clinical and service use data from the Ontario Resident Assessment Instrument-Home Care (RAI-HC) database, a repository of all completed RAI-HC assessments in Ontario, a province of approximately 13.2 million people. The RAI-HC evaluates the care needs of all long-stay home care clients in the province, i.e. those expected to receive services for longer than 60 days. The assessment consists of over 300 questions designed to generate Client Assessment Protocols (CAPs) that help with further assessment and care planning, as well as to provide outcome measures for cognition, depression and physical function. Trained clinicians conduct the RAI-HC assessments and use clinical judgment to record diagnoses; they verify the accuracy of the recorded information through discussions with physicians, family and caregivers, and review medical records if necessary. The RAI-HC is considered both reliable and valid, and the items contained within have excellent inter-rater and test-retest reliability.[33-36] The RAI-HC database contains detailed clinical and demographic information observed in the previous 7 days, including cognitive status, mood and behaviour patterns, informal support services, physical function, clinical diagnoses, prescription and non-prescription medication use, and acute service utilization in the previous 90 days, including hospitalizations and ED visits. This breadth of information provides a comprehensive description of all long-stay home care clients within Ontario.

### *Sample*

All home care clients aged 65 years or older who received their most recent RAI-HC assessment between January 2004 and December 2007 were eligible for this analysis, regardless of functional or cognitive status, or presence of comorbidity (N = 264 030). Using only the most recent assessment allowed for a prevalence sample, providing a comprehensive profile of HF clients in home care. Assessments took place either in a community or hospital setting; this study included only clients assessed in the community.

The Office of Research at the University of Waterloo provided ethics approval for our analyses of the anonymized data.

### *Measures*

The RAI-HC includes valid and reliable items to assess HF (as well as other conditions);[37] clients were defined as having HF if this condition was recorded in the assessment. Trained assessors routinely verify this information through self-report, discussions with caregivers and health providers, review of medical records and more. Accuracy of the diagnostic and medication information collected using the interRAI instruments has also been established.[37] Among individuals with HF in nursing homes and LTC facilities, the positive predictive value and sensitivity for the interRAI diagnosis of HF was greater than 0.80 compared to that found in administrative databases.[37,38] Clinical measures such as ejection fraction and New York Heart Association (NYHA) class were not available from this data source.

Based on previous literature and in consultation with a geriatrician,* we used key demographic and health-related variables to describe the HF sample,[1,11,39,40] including age, gender, living arrangement, marital status, caregiver presence, caregiver stress,

* One of our research team, Dr. G. A. Heckman.

health region within Ontario (as defined by the geographic boundaries of each of the 14 Community Care Access Centres [CCACs], which are aligned with Local Health Integration Networks in Ontario), daily pain, edema, falls, number of medications, shortness of breath, incontinence and presence of comorbidity. We used the following comorbidities to describe this sample: coronary artery disease (CAD), arthritis, diabetes, reactive airway disease (including asthma, chronic obstructive pulmonary disease [COPD] and emphysema) and hypertension. The analysis also included five health index scales for functional ability, cognition, depression and health instability. These were: (1) the Activities of Daily Living (ADL) self-performance hierarchy scale (range 0–6); (2) the Instrumental Activities of Daily Living (IADL) scale (range 0–6); (3) the Cognitive Performance Scale (CPS) (range 0–6); (4) the Depression Rating Scale (DRS) (range 0–14); and (5) the Changes in Health, End-stage disease and Signs and Symptoms (CHESS) scale (range 0–5).[35,41-44] Each scale has been developed and validated for use with the RAI-HC, and higher scores in each measure indicate more severe impairment.[36,41-44] Using the RAI-HC, we captured and analyzed the use of nursing, homemaking, physiotherapy and meal services in the previous 7 days, and hospitalizations, ED visits and use of emergent care (defined as any unplanned visit to a non-ED health provider) in the previous 90 days.

### *Analysis*

We collapsed scores from each of the five health index scales used (ADL, IADL, CPS, DRS and CHESS) into three levels to differentiate between levels of impairment, divided the variables for age, falls, hospitalizations, ED visits and use of emergent care into three levels, and analyzed use of nursing, homemaking, physiotherapy and meal services in the home by comparing receipt of any service versus no services. We excluded three classes of commonly used HF medications (angiotensin-converting enzyme inhibitors, angiotensin receptor blockers and beta-adrenergic receptor blockers) from the medication counts. Comorbidity and medication counts were collapsed into three and four levels, respectively. We tested for differences in characteristics between groups using unpaired, two-tailed t-tests, for variance for continuous variables using Satterthwaite's unequal variance assumption and for categorical variables using chi-square tests (significance level $p < .05$). Stratification by age groups addressed potential confounding of observed group differences with clinical and service use variables.

All analyses were conducted using SAS software (version 9.0, SAS Institute Inc., Cary, NC).

## Results

### *Heart failure client sample*

Between January 2004 and December 2007, the RAI-HC assessed 264 030 unique clients and identified 39 247 home care clients with HF (14.9%) in total. The proportion of clients with HF in each CCAC varied significantly ($p < .0001$) (see Figure 1), and was highest in the Northeast CCAC (19.5%, 2899/14907) and lowest in the Central west CCAC (11.3%, 996/8824).

### *Demographic characteristics*

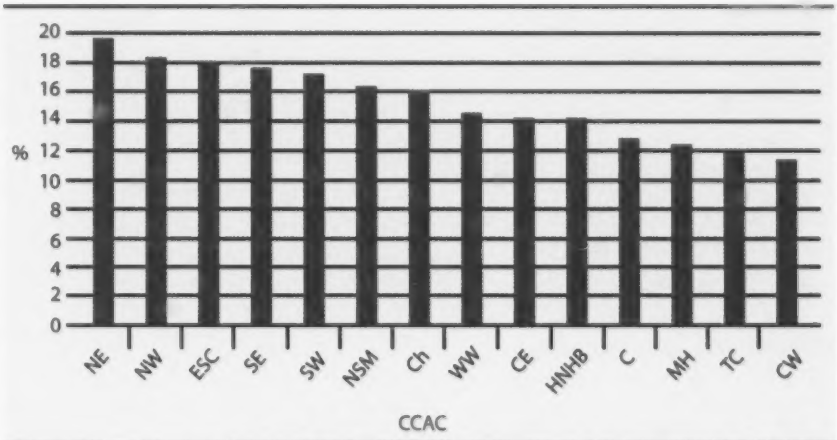
Table 1 shows the demographic characteristics of clients according to the presence of HF. Given the size of the sample, most observed differences are statistically significant. Compared with clients without HF, those with HF are older (mean age 83.5 years vs. 81.8 years, standard deviation [SD] 7.5 and 7.6, respectively), less likely to be women and less likely to be living alone. More clients with HF have caregivers, but there is no significant difference in levels of caregiver stress.

### *Clinical characteristics*

Table 2 shows the clinical characteristics of home care clients by HF status. Again, due to the large sample size most observed differences are statistically significant; only clinically significant findings are reported here. HF clients have more complex functional needs than those without HF and exhibit more health instability (as measured by the CHESS scale); as expected, they also experience significantly higher levels of edema and shortness of breath. They have less cognitive impairment, as measured by the CPS scale, although the overall proportion of HF patients with some degree of cognitive impairment is high. Prevalence of depression or a history of falls in the previous 90 days does not differ by HF status.

HF clients use more medications and have more comorbid conditions than those without HF. After exclusion of three classes

**FIGURE 1**
**Variation in prevalence of heart failure by Community Care Access Centre among home care clients 65 years and over, Ontario, 2004–2007 (N = 264 030)**




Abbreviations: C, Central; CCAC, Community Care Access Centre; CE, Central East; Ch, Champlain; CW, Central west; ESC, Erie St. Clair; HF, heart failure; HNHB, Hamilton Niagara Haldimand Brant; MH, Mississauga Halton; N, sample size; NE, Northeast; NW, Northwest; NSM, North Simcoe Muskoka; SE, Southeast; SW, Southwest; TC, Toronto Central; WW, Waterloo Wellington.

**TABLE 1**
**Demographic characteristics of home care clients, 65 years and older, Ontario, 2004–2007 (N = 264 030)**

| Characteristic | | HF sample (n = 39 247) % | Non-HF sample (n = 224 783) % | *p*-value |
|---|---|---|---|---|
| Age | 65–74 | 12.9 | 18.8 | < .0001 |
| | 75–84 | 39.0 | 43.0 | |
| | 85+ | 48.1 | 38.2 | |
| Gender | Female | 64.1 | 66.6 | < .0001 |
| Married | | 35.0 | 38.1 | < .0001 |
| Living alone | | 32.7 | 34.5 | < .0001 |
| Caregiver available | | 87.3 | 85.9 | < .0001 |
| Caregiver stress | | 16.7 | 17.0 | .08 |

Abbreviations: HF, heart failure; N, overall sample size; n, sample size; *p*, statistical significance.

of medications recommended for the treatment of HF (angiotensin-converting enzyme inhibitors, angiotensin receptor blockers and beta-adrenergic receptor blockers), the mean number of medications in the HF group is 9.3 (SD = 4.1) compared with 7.2 (SD = 2.9) for the group without. Further, 58.0% of the HF sample take 9 or more medications compared to only 35.0% of clients without HF. Almost half the clients with HF (45.1%) have five or more comorbid conditions, while only 26.5% of those without HF experience that level of comorbidity. Hypertension, arthritis, CAD, diabetes, osteoporosis and reactive airway disease (including COPD) are the most prevalent comorbidities in the entire sample studied. Except for osteoporosis, rates of comorbidity are higher among clients with HF. Stratification was done to explore potential confounding by age (not shown) and, apart from some variation in rates of depression and falls, there are no differences due to age for the clinical characteristics presented.

*Home care and acute service use*

Clients with HF receive significantly more nursing, homemaking and meal services compared with the group without HF (see Table 3), though receipt of physiotherapy services is low in both groups. Home care clients with HF received an average of 1.3 days of nursing services in the 7 days prior to RAI-HC assessment while clients without HF received an average of 1.0 days. HF clients are hospitalized more frequently, with 37.4% hospitalized more than once in the previous 90 days compared to only 26.1% of clients without HF. They also report significantly more ED visits and use more emergent care. We explored potential confounding by age using stratification, and the results do not differ from those reported in Table 3.

## Discussion

Our study provides a comprehensive description of older home care clients with HF in Ontario. The extensive RAI-HC data allowed us to examine many demographic and clinical characteristics as well as service use, both through home care and acute care services. These descriptors are useful in identifying care needs as well as patterns of service use among older, community-dwelling home care clients. These analyses are also useful in identifying areas for further study or intervention strategies.

The clustering of diseases that share risk factors with HF, such as diabetes, as well as the clustering of diseases that can precipitate HF, such as hypertension and CAD, is expected among clients with HF. These data show this clustering and provide an estimate of their co-occurrence in this older cohort. The observed clustering of HF with other diseases of aging, such as arthritis and reactive airways disease, indicates that this group is more complex medically. Further, these particular comorbidities may, in the setting of a history of HF, present additional therapeutic challenges (e.g. NSAIDs for arthritis) and diagnostic challenges (e.g. dyspnea from HF or reactive airways).

The complex needs of the HF group are also reflected in the significantly higher levels of medication use in this group, even after adjusting to exclude three classes of medications recommended for HF. This means that these clients need to be more active in monitoring for adverse drug events as a component of their self-care.

HF clients are significantly older than their counterparts without HF. Older home care clients with HF exhibit more complex clinical characteristics than those without (Table 2); they have more health instability (as measured by the CHESS scale), are less able to look after themselves (impaired in instrumental and basic ADLs), and experience more daily pain, edema, shortness of breath and incontinence. While shortness of breath is more prevalent among HF clients, this symptom is not universal in this group, likely because such individuals are frail, and present atypically, especially among older populations.[1,45,46] However, it may also be possible that such hallmark symptoms are not present in the sample due to proper management of HF through pharmacotherapy and other treatment modalities. The significantly higher prevalence of daily pain and incontinence among the HF group may represent common yet underappreciated HF manifestations,[1,45] as may the overall higher prevalence of other comorbid conditions in this group.

Clients with HF are less likely to be severely cognitively impaired than clients without HF, though rates of cognitive impairment are still high among both groups. Cognitive impairment in persons with HF is associated with a poorer outcome, including a greater risk of mortality and hospitalization, and consequently institutionalization. In a cross-sectional study such as this, people with HF and concomitant cognitive impairment may be so unable to look after themselves that they have been referred to more intensive care settings.[30] Alternately, cognitive impairment may be underestimated through CPS scores, as IADL impairment is also prevalent among clients with

**TABLE 2**
**Clinical characteristics of home care clients based on RAI-HC assessment, 65 years and older, Ontario, 2004–2007 (N = 264 030)**

| | | HF sample (n = 39 247) % | Non-HF sample (n = 224 783) % | *p*-value |
|---|---|---|---|---|
| Activities of Daily Living (ADL) hierarchy scale[a] | 0 | 62.1 | 64.5 | |
| | 1–2 | 24.1 | 22.6 | < .0001 |
| | 3+ | 13.8 | 12.9 | |
| Instrumental Activities of Daily Living (IADL) scale[a] | 0 | 2.2 | 4.6 | |
| | 1–2 | 17.1 | 21.4 | < .0001 |
| | 3+ | 80.7 | 74.0 | |
| Cognitive Performance Scale[a] | 0 | 48.3 | 46.5 | |
| | 1–2 | 41.5 | 39.5 | < .0001 |
| | 3+ | 10.2 | 14.0 | |
| Depression Rating Scale[b] | 0 | 63.0 | 63.8 | |
| | 1–2 | 23.3 | 22.5 | .94 |
| | 3+ | 13.7 | 13.7 | |
| CHESS scale[c] | 0 | 20.5 | 33.0 | |
| | 1–2 | 58.1 | 55.4 | < .0001 |
| | 3+ | 21.4 | 11.6 | |
| Daily pain | | 48.9 | 45.3 | < .0001 |
| Edema | | 37.0 | 21.4 | < .0001 |
| Shortness of breath | | 46.5 | 21.2 | < .0001 |
| Incontinence | | 43.4 | 39.1 | < .0001 |
| Falls | 0 | 67.9 | 68.8 | |
| | 1–2 | 24.8 | 24.0 | .42 |
| | 3+ | 7.3 | 7.2 | |
| Medication count[d] | 0 | 1.1 | 2.6 | |
| | 1–4 | 9.1 | 23.8 | < .0001 |
| | 5–8 | 31.8 | 38.5 | |
| | 9+ | 58.0 | 35.0 | |
| Comorbid conditions | 0–1 | 5.9 | 11.8 | |
| | 2–4 | 49.0 | 61.7 | < .0001 |
| | 5+ | 45.1 | 26.5 | |
| Common comorbidities | Hypertension | 63.2 | 54.5 | < .0001 |
| | Arthritis | 58.8 | 52.5 | .0002 |
| | CAD | 46.2 | 23.6 | < .0001 |
| | Diabetes | 32.7 | 22.6 | < .0001 |
| | Reactive Airway Disease[e] | 28.7 | 15.0 | < .0001 |
| | Osteoporosis | 21.1 | 22.1 | < .0001 |

Abbreviations: CAD, Coronary Artery Disease; CHESS, Changes in Health, End-stage disease and Signs and Symptoms; HF, heart failure; N, overall sample size; n, sample size; *p*, statistical significance; RAI-HC, Resident Assessment Instrument-Home Care.

[a] 0 = no impairment; 1–2 = mild impairment; 3+ = severe impairment.

[b] 0 = no indicators; 1–2 = some indicators; 3+ = many indicators.

[c] Changes in Health, End-stage disease and Signs and Symptoms; 0 = no instability; 1–2 = some instability; 3+ = severe instability.

[d] Medication count excluded the following: Angiotensin-converting enzyme inhibitors (benazepril, captopril, cilazapril, enalapril, fosinopril, lisinopril, perindopril, quinapril, ramipril, trandolapril), beta-adrenergic receptor blockers (acebutolol, atenolol, bisoprolol, carvedilol, metoprolol, nadolol, propranolol) and angiotensin receptor blockers (candesartan, eprosartan, irbesartan, losartan, telmisartan, valsartan).

[e] includes asthma, chronic obstructive pulmonary disease (COPD), and emphysema

HF, reflecting the presence of executive dysfunction common in this population.[30] Atypical symptoms of HF in older populations may include alterations in mood and behavioural symptoms, but the similar rates of depression among HF and non-HF clients do not support this interpretation.[46,47] History of falls is also similar between the two groups (Table 2), and fall prevalence is lower than reported in similar populations.[48] These results indicate that the clinical complexity of HF clients receiving home care services is more apparent through functional characteristics such as ADL and IADL impairment than cognitive or depressive characteristics.

Given the clinical characteristics and medical complexity of home care clients with HF, it is likely that there are many barriers to self-care. An indirect indication of difficulty with self-care may be the high rates of access to an informal caregiver. It is possible that without caregivers, clients with HF are at higher risk of death or placement in an LTC facility and are thus less likely to be seen in this home care sample.

Managing multiple medical conditions and medications, and dealing with depression, cognitive impairment and functional decline are likely all barriers to effective self-care. Cognitive impairment and depressive symptoms are present in 51.7% and 37.0% of clients with HF, respectively. Clinic-based CDM programs may not be designed to overcome such barriers to self-care, and the care setting may be inappropriate for such persons with HF. Functional impairment is high among home care clients with HF and may limit access to clinic-based programs. Further, having to schedule and attend numerous appointments for follow-up of multiple chronic conditions with many care providers may also be a barrier to attending clinic-based programs. Transitional care programs for seniors, in which specially trained Advanced Practice Nurses help coordinate care and enhance the self-care skills of patients with HF and their caregivers reduce readmission rates after discharge from hospital.[49] However, the extension of such programs to frail home care clients with HF has not been evaluated. Home care may be a more suitable setting than LTC facilities in which to provide CDM for these medically complex clients.[50] InterRAI assessment instruments used in the home care setting can offer risk assessment for adverse outcomes, identify barriers to self-care and provide a potential platform for CDM delivery.

The geographic variation in HF prevalence is an interesting finding. Due to the standardized training given to RAI assessors throughout the province, it is unlikely that these are due to differences between raters in recording diagnoses. Given that HF risk increases with age, the age structures of the client bases of each CCAC may explain some of this variation. HF prevalence, however, is not highest in the CCACs with the oldest populations. Thus, such variations may indicate differences in access to home care services for older individuals with HF or, conversely, different management strategies of HF on the part of the CCAC. Some CCACs may be more likely to push for LTC admission for clients with HF, while others may promote more aggressive management within the home. There are other implications of such variations in HF prevalence, and such profiles could help CCACs prioritize service planning, initiate chronic disease management strategies and re-allocate staffing as necessary.

This descriptive work demonstrates that (1) HF is prevalent among older home care clients in Ontario and (2) clients with HF are more clinically complex, using home care and acute care more frequently than their counterparts without HF. There are some limitations to this work. First, the cross-sectional study design allows a snapshot of this sample during a given time period, but does not allow any assessment of the temporality of the associations observed. For example, we do not know whether use of services followed or preceded HF diagnosis. Further, we did not examine the reason for

**TABLE 3**
**Home care and acute health care service use among home care clients, 65 years and older, Ontario, 2004–2007 (N = 264 030)**

| | | HF sample (n = 39 247) % | Non-HF sample (n = 224 783) % | *p*-value |
|---|---|---|---|---|
| **Home care service use[a,b]** | | | | |
| Nursing | | 39.4 | 29.8 | < .0001 |
| Homemaking | | 46.3 | 40.3 | < .0001 |
| Meals | | 20.8 | 18.4 | < .0001 |
| Physiotherapy | | 7.8 | 9.0 | < .0001 |
| **Acute health care service use[c]** | | | | |
| Hospitalizations | 0 | 62.6 | 74.0 | < .0001 |
| | 1 | 28.8 | 22.5 | |
| | 2+ | 8.6 | 3.6 | |
| Emergency Department | 0 | 78.1 | 81.7 | < .0001 |
| | 1 | 16.0 | 14.2 | |
| | 2+ | 5.9 | 4.1 | |
| Emergent Care | 0 | 91.2 | 92.9 | < .0001 |
| | 1 | 6.5 | 5.5 | |
| | 2+ | 2.3 | 1.6 | |

Abbreviations: HF, heart failure; N, overall sample size; n, sample size; *p*, statistical significance; RAI-HC, Resident Assessment Instrument-Home Care.

[a] Service use measured as any vs. none.

[b] In the seven days prior to RAI-HC assessment.

[c] In the 90 days prior to RAI-HC assessment.

hospitalizations, ED use or emergent care use. These data indicate, however, that the more clinically complex clients with HF do indeed use more services both in the home and in the broader health care system. Additionally, these data do not include information regarding HF severity, which may influence service use, although the CHESS scale in the assessment allows some assessment of health instability and can be predictive of mortality in LTC patients.[51] Clients with HF scored significantly higher on this item, indicating more disease instability overall. Another limitation is that this sample is drawn from clients already receiving home care service in Ontario and is not representative of other populations, either in institutions or in the community, that do not seek out or receive referrals for home care services. Lastly, given the demographics of this sample, it is likely that HF with preserved ejection fraction (HFPEF) is prevalent. HFPEF is more common in women and is thought to account for more than half the HF cases in those older than 75 years.[52,53] Given that almost 80% of the sample with HF was older than age 75, HFPEF likely affects a large proportion of these clients. This could not be verified from the data set used, but is worth noting as it has implications for CDM. There is much less evidence about the effectiveness of pharmacotherapy in the management of HFPEF compared to HF with reduced ejection fraction. Other aspects of HF management, however, are applicable to both populations. As better treatment modalities are identified for HFPEF, CDM programs will need to adapt accordingly.

This research has unique strengths. It provides a clear picture of the burden of HF in home care clients in Ontario and allows regional differences to be identified. It makes use of the extensive information available in the RAI-HC assessment to richly describe the clinical characteristics, presence of other diseases and service use in this population. Lastly, it assesses all long-stay home care clients in Ontario; since the number of HF clients identified in this sample is quite large, we can fully describe the clinical and functional characteristics of HF clients.

Our results depict home care clients with HF as a more complex, high-needs group with more medication use, more frequent use of health care services and many potential barriers to self-care, as shown by the high levels of functional impairment, cognitive impairment, depression, comorbidity and medication use. Any new CDM strategy for home care clients with HF should take these factors into consideration. Capable caregivers may have an important role to play, although programs would need to be designed to avoid undue caregiver stress. Targeting intervention strategies to improve self-care skills may significantly reduce the burden on other parts of the health care system. Improving communication between primary care providers, geriatric or cardiology consultants, and home care could allow such vulnerable populations to remain at home and independent. Such interventions would align well with the Aging at Home Strategy in Ontario, as well as with the Comprehensive Canadian Heart Health Strategy and Action Plan. An initial step to such strategies may be to identify and target the highest-needs individuals for such interventions. This work has provided a potentially important first step in achieving that goal.

## Acknowledgements

The authors are grateful to the Change Foundation for financially supporting this research. Andrea D. Foebel, Erin Y. Tjam and Suzanne L. Tyas have no financial conflicts. Dr. George A. Heckman has received research funding and/or honoraria from the Heart and Stroke Foundation of Ontario, Novartis, Pfizer, and Janssen-Ortho Inc. John P. Hirdes is supported as the Ontario Home Care Research and Knowledge Exchange Chair by the Ontario Ministry of Health and Long Term Care.

## References

1. Arnold JM, Liu P, Demers C, Dorian P, Giannetti N, Haddad H, Heckman GA, Howlett JG, Ignaszewski A, Johnstone DE, Jong P, McKelvie RS, Moe GW, Parker JD, Rao V, Ross HJ, Sequeira EJ, Svendsen AM, Teo K, Tsuyuki RT, White M; Canadian Cardiovascular Society. Canadian Cardiovascular Society consensus conference recommendations on heart failure 2006: diagnosis and management. Can J Cardiol. 2006;22(1):23-45.

2. Ross H, Howlett J, Arnold JO, Liu P, O'Neill B, Brophy J, Simpson C, Sholdice M, Knudtson M, Ross D, Rottger J, Glasgow K. Treating the right patient at the right time: access to heart failure care. Can J Cardiol. 2006;22(9):749-754.

3. American Heart Association. Heart disease and stroke statistics – 2003 update [Internet]. Dallas (TX): American Heart Association; 2002 [cited 2010 Oct 25]: 1-46. Available from: http://www.americanheart.org/downloadable/heart/1059017971148200 3HDSStatsBookREV7-03.pdf

4. Curtis LH, Whellan DJ, Hammill BG, Hernandez AF, Anstrom KJ, Shea AM, Schulman KA. Incidence and prevalence of heart failure in elderly persons, 1994-2003. Arch Int Med. 2008;168(4):418-24.

5. Tu JV, Nardi L, Fang L, Liu J, Khalid L, Johansen H; Canadian Cardiovascular Outcomes Research Team. National trends in rates of death and hospital admissions related to acute myocardial infarction, heart failure and stroke, 1994-2004. CMAJ. 2009;180:E118-E125.

6. Johansen H, Strauss B, Arnold JM, Moe G, Liu P. On the rise: the current and projected future burden of congestive heart failure hospitalization in Canada. Can J Cardiol. 2003;19(4):430-5.

7. Rouleau JL. Treatment of congestive heart failure: present and future. Can J Cardiol. 2005;21(12):1084-8.

8. Public Health Agency of Canada. Tracking heart disease and stroke in Canada. [Internet]. Ottawa (ON): Public Health Agency of Canada; 2009 [cited 2010 Oct 26]:1-132. Available from: http://www.phac-aspc.gc.ca/publicat/2009/cvd-avc/pdf/cvd-avs-2009-eng.pdf

9. Heart and Stroke Foundation of Canada. The changing face of heart disease and stroke in Canada 1999. Ottawa (ON): Heart and Stroke Foundation; 2000.

10. Havranek EP, Masoudi FA, Westfall KA, Wolfe P, Ordin DL, Krumholz HM. Spectrum of heart failure in older patients: results from the National Heart Failure project. Am Heart J. 2002;143:412-7.

11. Fitchett D, Rockwood K, Chan BT, Schultz S, Bogaty P, Gillis A, Arnold M, Miller F, Graham MM, Ghali WA, Cartier R, Chow CM, Grymonpre R, Ogilvie R, Rochon P, Niznick J, Grover S, Kavanah T, Triscott J, Dafoe W, McCartney N, Rodney P, Howlett J, Chockalingam A, Dagenais G, Dalziel W, Fodor G, Goodman S, Kerr C, Power B, Murphy K. Cardiovascular Society Consensus Conference 2002: Management of heart disease in the elderly patient. Can J Cardiol. 2004;20 Suppl A:7A-16A.

12. Wilson E. Congestive heart failure: a national priority. Can J Cardiol. 2001;17(12):1243-4.

13. Tsuyuki RT, Shibata MC, Nilsson C, Hervas-Malo M. Contemporary burden of illness of congestive heart failure in Canada. Can J Cardiol. 2003;19(4):436-8.

14. Howlett JG, Johnstone DE, Sketris I, O'Reilly M, Horne GS, Cox JL. Identifying opportunities to address the congestive heart failure burden: the Improving Cardiovascular Outcomes in Nova Scotia (ICONS) study. Can J Cardiol. 2003;19:439-44.

15. Naylor MD. A decade of transitional care research with vulnerable elders. J Cardiovasc Nurs. 2000;14:1-14.

16. Burns RB, McCarthy EP, Moskowitz MA, Ash A, Kane RL, Finch M. Outcomes for older men and women with congestive heart failure. J Am Geriatr Soc. 1997;45:276-80.

17. Canadian Institute for Health Information. Alternate level of care in Canada [Internet]. Ottawa (ON): CIHI; 2009 Jan [cited 2010 Jan 10]:1-20. Available from: http://secure.cihi.ca/cihiweb/products/ALC_AIB_FINAL.pdf

18. Canadian Institute for Health Information. Patient pathways: transfers from continuing care to acute care. Ottawa (ON): CIHI; 2009. Report No.: ISBN: 978-1-55465-476-5.

19. Bowman CE, Elford J, Dovey J, Campbell S, Barrowclough H. Acute hospital admissions from nursing homes: some may be avoidable. Postgrad Med J. 2001;77:40-2.

20. Coburn AF, Keith RG, Bolda EJ. The impact of rural residence on multiple hospitalizations in nursing facility residents. Gerontologist. 2002;42:661-6.

21. Rizza P, Bianco A, Pavia M, Angelillo IF. Preventable hospitalization and access to primary care in an area of Southern Italy [Internet]. BMC Health Serv Res. 2007 [cited 2010 Jan 10]:7:1-8. Available from: http://www.biomedcentral.com/1472-6963/7/134

22. Finn JC, Flicker L, Mackenzie E, Jacobs IG, Fatovich DM, Drummond S, Harris M, Holman DC, Sprivulis P. Interface between residential aged care facilities and a teaching hospital emergency department in Western Australia. Med J Aust. 2006;184:432-5.

23. Finucane P, Wundke R, Whitehead C, Williamson L, Baggoley C. Use of in-patient hospital beds by people living in residential care. Gerontology. 2000;46:133-8.

24. Smith ER, on behalf of the CHHS-AP Steering Committee. Canadian heart health strategy and action plan: building a heart healthy Canada [Internet]. Ottawa (ON): 2009 [cited 2009 Dec 14]. Available from: http://www.nwtsrc.com/content/news/research_reports/09_chhs_report.pdf

25. Lorig KR, Holman H. Self-management education: history, definition, outcomes, and mechanisms. Ann Behav Med. 2003;26(1):1-7.

26. Phillips CO, Wright SM, Kern DE, Singa RM, Shepperd S, Rubin HR. Comprehensive discharge planning with postdischarge support for older patients with congestive heart failure: a meta-analysis. JAMA. 2004;291(11):1358-67.

27. McConaghy JR, Smith SR. Outpatient treatment of systolic heart failure. Am Fam Physician. 2004;70(11):2157-64.

28. Rich MW. Management of heart failure in the elderly. Heart Fail Rev. 2002;7(1):89-97.

29. Dickson VV, Tkacs N, Riegel B. Cognitive influences on self-care decision making in persons with heart failure. Am Heart J. 2007;154(3):424-31.

30. Heckman GA, Patterson CJ, Demers C, St. Onge J, Turpie ID, McKelvie RS. Heart failure and cognitive impairment: challenges and opportunities. Clin Interv Aging. 2007;2(2):209-18.

31. McDonald K. Disease management of chronic heart failure in the elderly: issues and options. Dis Manag Health Out. 2007;15(6):333-9.

32. Scott IA. Chronic disease management: a primer for physicians. Internal Med J. 2008; 38(6):427-37.

33. Poss JW, Jutan NM, Hirdes JP, Fries BE, Morris JN, Teare GF, Reidel K. A review of evidence on the reliability and validity of Minimum Data Set data. Healthc Manage Forum. 2008;21:33-9.

34. Hirdes JP, Ljunggren G, Morris JN, Frijters DH, Finne Soveri H, Gray L, Björkgren M, Gilgen R. Reliability of the interRAI suite of assessment instruments: a 12-country study of an integrated health information system. BMC Health Serv Res. 2008;8:277.

35. Morris JN, Fries BE, Morris SA. Scaling ADLs within the MDS. J Gerontol A Biol Sci Med Sci. 1999;54:M546-53.

36. Hartmaier SL, Sloane PD, Guess HA, Koch GG, Mitchell CM, Phillips CD. Validation of the Minimum Data Set Cognitive Performance Scale: agreement with the Mini-Mental State Examination. J Gerontol A Biol Sci Med Sci. 1995;50:M128-33.

37. Gambassi G, Landi F, Peng L, Brostrup-Jensen C, Calore K, Hiris J, Lipsitz L, Mor V, Bernabei R. Validity of diagnostic and drug data in standardized nursing home resident assessments: potential for geriatric pharmacoepidemiology. SAGE Study Group. Systematic Assessment of Geriatric drug use via Epidemiology. Med Care. 1998;36(2):167-79.

38. Wodchis WP, Naglie G, Teare GF. Validating diagnostic information on the Minimum Data Set in Ontario hospital-based long-term care. Med Care. 2008;46(8):882-7.

39. Tsuyuki RT, Ackman ML, Montague TJ; Clinical Quality Improvement Network Investigators. Effects of the 1994 Canadian Cardiovascular clinical practice guidelines for congestive heart failure. Can J Cardiol. 2002;18:147-52.

40. Heckman GA, Misiaszek B, Merali F, Turpie ID, Patterson CJ, Flett N, McKelvie RS. Management of heart failure in Canadian long-term care facilities. Can J Cardiol. 2004;20(10):963-9.

41. Hirdes JP, Frijters DH, Teare GF. The MDS-CHESS scale: a new measure to predict mortality in institutionalized older people. J Am Geriatr Soc. 2003;51:96-100.

42. Morris JN, Fries BE, Mehr DR, Hawes C, Phillips C, Mor V, Lipsitz LA. MDS Cognitive Performance Scale. J Gerontol. 1994;49:M174-82.

43. Burrows AB, Morris JN, Simon SE, Hirdes JP, Phillips C. Development of a minimum data set-based depression rating scale for use in nursing homes. Age Ageing. 2000;29:165-72.

44. Landi F, Tua E, Onder G, Carrara B, Sgadari A, Rinaldi C. Minimum data set for home care: a valid instrument to assess frail older people living in the community. Med Care. 2000;38(12):1184-90.

45. Heckman GA, Demers C, McKelvie RS, Hogan DB. Heart failure in older adults. Canadian J Intern Med. 2007;2(4):24-6.

46. Rich MW. Heart failure in the 21st century: a cardiogeriatric syndrome. J Gerontol A Biol Sci Med Sci. 2001;56(2):M88-96.

47. Rockwood K. Acute confusion in elderly medical patients. J Am Geriatr Soc. 1989;37(2):150-4.

48. Cesari M, Landi F, Torre S, Onder G, Lattanzio F, Bernabei R. Prevalence and risk factors for falls in an older community-dwelling population. J Gerontol A Biol Sci Med Sci. 2002;57(8):M722-6.

49. McCauley KM, Bixby MB, Naylor MD. Advanced practice nurse strategies to improve outcomes and reduce cost in elders with heart failure. Dis Manage. 2006;9:302-10.

50. Marek KD, Popejoy L, Petroski G, Rantz M. Nurse care coordination in community-based long-term care. J Nurs Scholarsh. 2006;38:80-6.

51. Tjam EY, Pletz DE, Hirdes JP, SJ Smith, J Costigan, B Willwerth, J Poss. Prevention of avoidable acute care use by retirement and long term care residents: management of chronic heart failure through the use of an innovative inter-disciplinary education program for care providers (EPOCH study). Canadian Cardiovascular Society Conference; 2006 Oct; Vancouver, BC.

52. Aronow WS. Treatment of systolic and diastolic heart failure in the elderly. J Am Med Dir Assoc. 2006;7(1):29-36.

53. Mathew ST, Gottdiener JS, Kitzman D, Aurigemma G. Congestive heart failure in the elderly: the Cardiovascular Health Study. Am J Geriatr Cardiol. 2004 Mar-Apr;13(2):61-8.

# The effectiveness of implementing a reminder system into routine clinical practice: does it increase postpartum screening in women with gestational diabetes?

*A. K. Shea, PhD, MSc (1); B. R. Shah, MD, PhD (2,3,4); H. D. Clark, MD, MSc (5,7); J. Malcolm, MD (5); M. Walker, MD, MSc (6,7); A. Karovitch, MD, MEd (5,6); E. J. Keely, MD (5,6)*

## Abstract

**Introduction**: During regular care, women with previous gestational diabetes mellitus (GDM) rarely receive the recommended screening test for type 2 diabetes, a 2-hour oral glucose tolerance test (OGTT), in the postpartum period. The current study examined whether the implementation of a reminder system improved screening rates.

**Methods**: Based on our previous randomized control trial, we implemented a postpartum reminder (letter or phone call) protocol into routine care at two of three clinical sites. We verified postpartum testing by searching hospital laboratory databases and by linking to the provincial physician service claims database. The primary outcome was the proportion of patients who underwent an OGTT within 6 months of delivery.

**Results**: Women who received care in a setting using a reminder system were more likely to receive an OGTT within 6 months postpartum (28%) compared with usual care (14%). The OGTT rates for both reminder groups were lower than that found in our randomized control trial (28% vs. 60%).

**Conclusion**: Although the screening rates remain low, postpartum reminders doubled screening rates using the recommended test, the OGTT.

*Keywords: gestational diabetes, postpartum, screening, reminders, type 2 diabetes prevention*

## Introduction

Gestational diabetes mellitus (GDM), defined as hyperglycemia at the onset of pregnancy or first recognized in pregnancy, affects about 3% to 4% of non-Aboriginal women and up to 18% of Aboriginal women in Canada.[1,2] Although GDM and gestational impaired glucose tolerance (IGT) are associated with poor obstetrical outcomes, the most serious public health concern may be the 7-fold increased risk of developing type 2 diabetes (T2DM) compared to women with normal glucose tolerance in pregnancy.[3-6] The Canadian Diabetes Association (CDA) recommends that women with GDM have a 2-hour oral glucose tolerance test (OGTT) at 6 weeks to 6 months postpartum.[7] Recommendations from the International Workshop Conference on GDM suggest screening at 6 weeks postpartum using the 75-gram, 2-hour OGTT, which should then be repeated at one-year postpartum and then at least every 3 years thereafter.[8] A fasting glucose blood test alone misses approximately 40% of those with diabetes and fails to identify those with IGT.[9] When screened between 6 weeks and 3 months postpartum, 13% to 32% of women with GDM have IGT that may persist or later develop into T2DM.[10,11] The postpartum period therefore presents a unique opportunity for the identification of women at high risk of developing diabetes and provides an important opportunity for early intervention and prevention.

Although the importance of postpartum screening with an OGTT is known, screening rates remain disappointingly low in routine clinical practice.[12-14] Identified barriers to implementing the recommended postpartum screenings include poor communication between obstetrician and primary care provider, providers uncertain about screening recommendations, patients unaware of the risk of not screening and patients missing screening appointments due to competing time commitments.[15] Our group previously identified that the majority of women were not receiving the recommended postpartum screening in the Ottawa area of Ontario, Canada.[12] We did a randomized control trial (RCT) at The Ottawa Hospital (TOH) where the woman, her family physician, both of them or neither of them received a postal reminder at approximately 3 months postpartum to have an OGTT completed. If either the woman, the physician or both received the reminder, screening rates increased 4-fold from 14% (no reminder) to approximately 60%. Approximately 30% of the women in that study who completed the OGTT had an abnormal result.[16]

**Author references:**

1. Faculty of Medicine, University of Ottawa, Ottawa, Ontario, Canada
2. Institute for Clinical Evaluative Sciences, Toronto, Ontario, Canada
3. Department of Medicine, University of Toronto, Toronto, Ontario, Canada
4. Department of Medicine, Sunnybrook Health Sciences Centre, Toronto, Ontario, Canada
5. Department of Medicine, The Ottawa Hospital and University of Ottawa, Ottawa, Ontario, Canada
6. Department of Obstetrics & Gynecology, The Ottawa Hospital and University of Ottawa, Ottawa, Ontario, Canada
7. Ottawa Hospital Research Institute, Clinical Epidemiology Program, The Ottawa Hospital and University of Ottawa, Ottawa, Ontario, Canada

**Correspondence:** Dr. Erin Keely, Division of Endocrinology and Metabolism, The Ottawa Hospital, 4th Floor Riverside Campus, 1967 Riverside Drive, Ottawa, Ontario, Canada K1H 7W9; Tel.: (613) 738-8400 Ext. 81946; Fax: (613) 737-8396; Email: ekeely@ottawahospital.on.ca

Based on the results from the RCT, we implemented a reminder system into routine practice in two of three GDM clinical sites in the Ottawa area. The third site could not institute the reminder system due to logistics. The aim of our current study was to compare whether our implementation of the reminder system at the two sites made a difference in screening rates using the CDA-recommended 2-hour OGTT. We hypothesized that the women who had received care at sites implementing the reminder system would have a higher postpartum screening rate using an OGTT compared to those who had not. The analyses were based on an intention-to-treat model.

## Methods

This study was approved by the Research Ethics Committee of both The Ottawa Hospital (TOH) and the Queensway Carleton Hospital (QCH). TOH is a university-affiliated tertiary centre in Ottawa, Ontario, Canada, that provides services to a catchment area of 900 000 people. TOH provides obstetrical services at two of its campuses, the Civic Campus (west) and the General Campus (east), each of which performs approximately 3500 deliveries per year. The QCH is a community-based hospital in the west end of the city that serves a population of over 400 000 and provides 2800 deliveries per year. Most women in the region are referred to one of these three sites for management of their GDM. All primary care is provided by family physicians.

We identified all the attendees at GDM education classes at one of these three sites between July 1, 2007, and June 30, 2008. Women were diagnosed with GDM following either a 50-g glucose challenge test (GCT) or a 75-g OGTT using the CDA practice guidelines criteria.[7] A GDM diagnosis was made if the woman had either (1) a 50-g GCT with a plasma glucose level greater than or equal to 10.3 mmol/L or (2) a 75-g OGTT with two of the following three results: fasting plasma glucose level greater than or equal to 5.3 mmol/L; 60-minute plasma glucose levels greater than or equal to 10.6 mmol/L; or 120-minute plasma glucose level greater than or equal to 8.9 mmol/L.[7] All the GDM education classes give information on the risks of GDM including the development of diabetes postpartum, on individualized nutrition counselling and on monitoring blood glucose at home, and patients return to the site for ongoing GDM care. At reminder site A (TOH, General Campus) and B (QCH) women were seen by an endocrinologist/internist for ongoing care and continued with their usual obstetrical care provider; at the non-reminder site (TOH, Civic Campus), women were seen by a high-risk obstetrician and obstetrical care could be transferred to the site if need be. Patients were referred to an internist if assistance with insulin management was required. Similar protocols for insulin initiation, based on the CDA recommendations, were used at all sites.

For Ontario residents, all physician visits, medical care and diagnostic testing are covered by the Ontario Health Insurance Plan (OHIP), provincial health insurance that is universally available without copayment. If patients lacked OHIP coverage, they were excluded from the study since postpartum testing could not otherwise be verified.

Approximately three months after delivery, patients from reminder site A were mailed a reminder that included information on the importance of diabetes screening and a laboratory requisition for an OGTT at a non-hospital-based laboratory, and patients from reminder site B were either sent a letter with a laboratory requisition or phoned or both. Patients from the non-reminder site did not receive a postal reminder or a reminder phone call. No sites provided routine postpartum follow-up visits for GDM.

We collected baseline characteristics and obstetrical outcomes by reviewing patient charts. We estimated socio-economic status using the neighbourhood income quintile, according to the patient's home postal code. Ethnicity and education level were not available. We searched through two sources to identify diabetes screening tests for the study participants: the hospital-based electronic record system to identify whether participants had completed postpartum diabetes screening at the hospital laboratory and records of billing claims from community laboratories, by linking each participant to the provincial physician service claims database using their unique health care number through the Institute for Clinical Evaluation Services (ICES). Because of the single-payer universal health care system in Ontario, the database includes information on all laboratory testing performed outside of the hospital setting, including the types and dates of tests. (The results of the laboratory tests are not available from these databases.)

The primary outcome was the proportion of patients who were screened for T2DM with an OGTT within 6 months of delivery. Two additional outcomes were (1) an alternate test that might have be used to screen for T2DM within 6 months of delivery (random glucose test, fasting glucose test or glycated hemoglobin [HbA1c] test) or (2) any test that might be used to screen for T2DM within 6 months of delivery (OGTT, random glucose test, fasting plasma glucose (FPG) test or HbA1c test).

Using chi-square tests and analysis of variance (ANOVA), we compared the baseline demographic, clinical and metabolic parameters between study participants and excluded participants and between the three sites. To compare screening rates at the three sites, we performed a chi-square test for each outcome versus site of delivery. We used logistic regression analyses to adjust for the following baseline characteristics: maternal age at delivery; socio-economic status; previous GDM; pre-pregnancy body mass index (BMI; normal vs. overweight vs. obese); GDM treatment (diet only vs. insulin); and family history of T2DM. We report unadjusted means and associated standard deviations for continuous variables, as well as the proportion of participants for each variable of interest (number and percent) for categorical variables. Differences are considered significant at $p \leq .05$.

## Results

We identified a total of 349 cases who attended the education classes at the three sites. Of these, 60 women did not meet the criteria for GDM and 27 did not have OHIP coverage (mostly because they were residents of the neighbouring province of Quebec) leaving 262 participants. The 27 excluded women differed from the

included participants in that there was a significantly greater proportion of cigarette smokers in the excluded group ($p$ = .002); they also gave birth to infants with a lower weight ($p$ = .028). However, the difference in birth weight did not remain significant when gestational age at delivery was controlled for ($p$ = .316). There were no other significant differences compared to the included participants, as seen in Table 1.

The majority of women (96.6%; 253/262) returned to the site for GDM care following their education class. Of the participants from the reminder sites, 92.2% (83/90) returned to reminder site A and 100% (55/55) returned to reminder site B, and were followed by an internist/endocrinologist for GDM care. Of the participants from the non-reminder site, 98.3% (115/117) returned and all but three were seen by the high risk obstetrician for GDM care; of these, 17.9% (21/117) were also seen by an internist/endocrinologist.

Hospital birth records were available for 91.6% (240/262) of participants. There were no differences among the sites for the following characteristics: birth weight; proportion of infants born > 4000 g; proportion of Caesarian sections; proportion of multiple gestation; proportion of primigravids or proportion of women experiencing pre-eclampsia (See Table 1). Women from the non-reminder site, however, did give birth earlier than women from reminder site B (38 vs. 39 weeks, $p$ = .010).

At reminder site A, 96.7% of participants were sent a postal reminder with a laboratory requisition (n = 3 not sent) following delivery, but 11.5% (10/87) of these were returned because the patient no longer lived at that address. Of the participants from reminder site B, 76.3% (42/55) were mailed a reminder letter, 14.5% (8/55) were phoned by a volunteer, and 7.3% (4/55) received both a letter and a phone call; one could not be reached by telephone and no letter was sent. No patients from the non-reminder site received postal reminders or phone calls.

In the intention-to-treat analysis using all participants, 21.7% (57/262) women completed the OGTT postpartum screening within 6 months of delivery, 23.3% (21/90) from reminder site A, 36.4% (20/55) from reminder site B and 13.7% (16/117) from the non-reminder site ($p$ = .01) (Table 2). When the reminder sites are combined, 28% (41/145) completed the OGTT, significantly more than those from the non-reminder site (chi-square [$\chi^2$] = 7.274; $p$ = .01; degrees of freedom [df] = 1). In the logistic regression analyses, significantly more women from reminder site B completed an OGTT compared to the non-reminder site (adjusted odds ratio [OR] = 3.10; $p$ = .03); reminder site A did not differ from either site in OGTT completion (Table 3). When we examined the occurrence of any glucose test (random/fasting glucose test, HbA1c or OGTT) in the 6 months following delivery, we found that 41.6% (109/262) of women had completed one or more of these tests. Of the 57 women who had had OGTTs, 81% (n = 46) had records of the test in the community laboratory billing claims database. There were no statistically significant differences among the sites for the proportion of women who completed either random/fasting glucose testing or HbA1c or any diabetes screening test.

Factors that may influence screening rates were entered into a logistic regression analysis (Table 3). Women treated using diet only (vs. insulin) were less likely to complete the OGTT (adjusted OR = 0.38; CI = 0.18–0.80; $p$ = .01). No other factors were found as significant predictors of OGTT testing. Paradoxically, women who were normal weight or overweight (vs. obese) were more likely to go for any postpartum glucose test (adjusted OR = 2.40; CI = 1.16–5.01 and adjusted OR = 3.10; CI = 1.42–6.77, respectively; $p$ = .03). A family history of T2DM and previous GDM did not have a significant effect on the participant undergoing postpartum diabetes screening.

## Discussion

We found that women with previous GDM who received care at sites where reminders are used for postpartum diabetes screening were more likely to receive the recommended test, the OGTT. The OGTT rates for both reminder groups were lower than that found in our RCT (28% vs. 60%), as expected in a comparative effectiveness study. Our rates of screening without reminders had not improved (13.7% of women from non-reminder site completed the OGTT, similar to 14.3% of women in the RCT non-intervention group). The OGTT screening rates were lower at reminder site A, but 14.4% of participants from this site did not actually receive the reminder and there was no telephone follow-up. Based on the intention-to-treat model, however, these women were still included in the analyses and participants from this group were still more likely to receive the OGTT.

Our results indicate that there were significantly fewer participants from the non-reminder site completing an OGTT compared to women from the reminder sites, but that there was no differences in the proportion that completed other glucose tests (random glucose test, FPG or HbA1c). Reluctance to perform OGTTs has been demonstrated in the general population of Ontario,[17] despite it being the best test for screening for diabetes as other types of testing may lead to false-negative results. In a recent large-scale cohort study, women with a history of GDM completed both the OGTT and the FPG; if only the FPG was used, 38% of those with prediabetes and 75% of those who met criteria for type 2 diabetes would have been missed.[18] Similarly, a Canadian study reported that when results from the FPG were used alone, 54% of women with diabetes would have been identified as normal.[9] In the current study, only about half of the women who were screened using any glucose test received the recommended test (OGTT, 21.7% vs. 41.6% any test), which suggests that the CDA guidelines are not being followed, thus missing opportunities for early intervention. Women with IGT and a history of GDM are more likely to progress to T2DM within 3 years compared to women with IGT and without a history of GDM (38.4% vs. 25.7%).[19] Many clinical trials have demonstrated that T2DM may be delayed, if not prevented, in these high risk patients through lifestyle modifications and pharmacotherapy.[19-22] In fact, women with previous GDM may benefit the most from pharmacotherapy.[19] Continued patient and provider education and service innovations are needed to improve use of an OGTT.

**TABLE 1**
**Baseline demographic, clinical and metabolic parameters of study participants**

| | Non-reminder group (N = 117) | Reminder group A[a] (N = 90) | Reminder group B[a] (N = 55) | Excluded (N = 27) | *p*-value |
|---|---|---|---|---|---|
| **Baseline characteristics** | | | | | |
| Maternal age at delivery (years) | 34.0 ± 5.4 | 33.5 ± 5.0 | 33.3 ± 4.0 | 33.7 ± 5.4 | .659 |
| Gestational age at GDM diagnosis (weeks) | 26.9 ± 4.0 | 27.8 ± 2.8 | 27.8 ± 2.7 | 26.6 ± 3.4 | .106 |
| Pre-pregnancy BMI (kg/m$^2$) | 27.6 ± 6.8 | 27.6 ± 6.0 | 25.4 ± 5.3[b] | 28.8 ± 7.0 | .039 |
| Category of BMI (n, %) | | | | | |
| Unknown | 0 (0.0) | 27 (30.0) | 1 (1.8) | | |
| Normal | 53 (45.3) | 23 (25.6) | 28 (50.9) | | |
| Overweight | 28 (23.9) | 23 (25.6) | 13 (23.6) | | |
| Obese | 36 (30.8) | 17 (18.9) | 13 (23.6) | | |
| Previous GDM | 30 (26.3) | 20 (22.5) | 6 (11.1) | 5 (18.5) | .082 |
| Primigravida | 35 (29.9) | 27 (30.0) | 16 (29.1) | 5 (18.5) | .992 |
| Cigarette smoking in pregnancy | 8 (6.8) | 2 (2.6) | 5 (9.1) | 6 (22.2) | .258 |
| Glucose level in challenge 50-g OGTT (mmol/L) | 11.1 ± 2.2 | 11.8 ± 1.8 | 11.2 ± 1.7 | 11.5 ± 1.9 | .202 |
| Glucose level at 0 min 75-g OGTT (mmol/L) | 5.4 ± 0.8 | 5.5 ± 0.7 | 5.2 ± 0.7 | 5.4 ± 0.7 | .35 |
| Glucose level at 60 min 75-g OGTT (mmol/L) | 11.8 ± 1.3 | 11.6 ± 1.4 | 11.7 ± 0.9 | 11.5 ± 1.1 | .803 |
| Glucose level at 120 min 75-g OGTT (mmol/L) | 9.4 ± 1.7 | 9.6 ± 1.8 | 9.6 ± 1.4 | 9.3 ± 1.3 | .835 |
| **GDM care** | | | | | |
| GDM treated with insulin | 45 (38.5) | 25 (27.8) | 14 (25.5) | 8 (29.6) | .131 |
| **Birth outcomes** | | | | | |
| Gestational age at delivery (weeks) | 38.0 ± 2.2 | 38.7 ± 2.5 | 39.0 ± 1.5[b] | 37.3 ± 3.3 | .01 |
| Infant birth weight (grams) | 3280.4 ± 682.6 | 3408.6 ± 690.0 | 3440.7 ± 513.8 | 3058.3 ± 670.0 | .233 |
| Multiple gestation | 6 (5.2) | 2 (2.8) | 0 (0.0) | 2 (7.7) | .196 |
| Pregnancy-induced hypertension | 12 (10.4) | 3 (4.2) | 5 (9.1) | 5 (19.2) | .655 |
| Preeclampsia | 7 (6.1) | 4 (5.6) | 2 (3.6) | 0 (0.0) | .655 |
| Caesarian section | 50 (43.9) | 27 (37.5) | 20 (36.4) | 12 (46.2) | .552 |
| Family Hx T2DM | 59 (50.4) | 51 (56.6) | 27 (49.1) | 13 (48.1) | .527 |
| **Income quintile (by postal code)** | | | | | |
| Missing | 2 (1.7) | 1 (1.1) | 0 (0.0) | n/a | .001[c] |
| 1 (lowest) | 32 (27.4) | 32 (35.6) | 3 (5.5) | n/a | |
| 2 | 19 (16.2) | 12 (13.3) | 13 (23.6) | n/a | |
| 3 | 27 (23.1) | 17 (18.9) | 13 (23.6) | n/a | |
| 4 | 19 (16.2) | 22 (24.4) | 10 (18.2) | n/a | |
| 5 (highest) | 18 (15.4) | 6 (6.7) | 16 (29.1) | n/a | |

Abbreviations: BMI, body mass index; GDM, gestational diabetes mellitus; Hx, medical history; N, overall sample size; OGTT, oral glucose tolerance test; p, significance; T2DM, type 2 diabetes mellitus.

Notes: n/a = data was not available due to lack of provincial insurance number to link data.

Data represent mean ± standard deviation or counts (%).

[a] Reminder groups A and B were compared to the non-reminder group using chi-square and analysis of variance (ANOVA) analyses.

[b] Significant versus non-reminder group.

[c] Reminder group B differs significantly by income quintile compared to reminder group A and the non-reminder group.

Several factors may play a role in completion of postpartum screening. There are differences in service delivery between our non-reminder and reminder sites. In particular, at the reminder sites all patients were seen by an internist/endocrinologist, whereas at the non-reminder site all patients saw a high-risk obstetrician and only saw the internist for insulin adjustments. However, given that the rate of screening was the same as in the non-intervention group in our RCT, and the model of care (other than the postpartum reminders) has remained the same at all sites, the difference is most likely due to the implementation of a reminder system. Further, despite our attempts to ensure that the reminder had been received and the patient was available for screening, there were 4 participants who were not sent a reminder and 10 mailed reminders were returned, indicating 9.6% in the reminder groups who were lost to follow-up. Also, participants in the RCT knew that they were taking part in a research study compared to the current study where women were not aware of this.

Greater contact with health care providers appears to increase screening rates. Visits to health care providers postpartum, either with an endocrinologist or during the 6-week routine follow-up visit where the provider ordered the test, were associated with higher rates of screening.[23,24] Similarly, in a cohort study of over 14 000 women with GDM, visits to an internal medicine or obstetrics/gynecology provider were independent and significant predictors of postpartum screening in the year post-delivery.[18] In our practice, no routine postpartum appointments are made with the internist/endocrinologist. Our study was limited in that we were not able to access the out-of-hospital records for postpartum care by an obstetrician or primary care provider.

Although there are no other direct studies comparing models of care delivery, case management may improve screening rates. One prospective cohort study followed women with GDM who were provided laboratory requisitions upon hospital discharge and also contacted at home by a case-manager who could perform the test; this led to an OGTT screening rate of 41%.[25] At Kaiser Permanente in Northern California, screening rates utilizing an OGTT increased from 16.6% to 71.5% when a nurse-managed care program was instituted.[18]

Women at highest risk of developing T2DM may not be returning for screening. In our study, women on insulin were more likely to complete postpartum screening, but obese women were least likely to do so, with a rate of only 28.8% completing any glucose screening. One prospective cohort study followed women with GDM who were provided laboratory requisitions upon hospital discharge and also contacted at home by a case-manager who could perform the test.[25] The women who did not return had a greater incidence of previous GDM, higher diagnostic glucose levels and were more likely to have been taking insulin during pregnancy, suggesting that women with less severe GDM were more likely to return for follow-up. We need further research on perceptions of risk vis-à-vis screening to find out why high-risk women are not being screened.

Our study has several limitations. We only followed women for 6 months postpartum in keeping with the CDA screening recommendations. (In our RCT study, we included testing done within one year.) The results from other studies are varied: one found that women will delay their testing up to 428 days postpartum,[14] whereas another demonstrated that 94.3% of women completed it by 12 weeks postpartum.[25] However, the performance of this study in one urban multicultural centre may limit the generalizability of the results.

In summary, the current study shows that reminders are an effective method of reinforcing guidelines for postpartum diabetes screening. However, the majority of women continue to not receive any glucose screening, let alone the recommended OGTT. Care providers should consider implementing a structured approach to postpartum follow-up of women with a history of GDM. Further studies should assess different methods of postpartum reminders and barriers to implementation.

**TABLE 2**
**The proportion of study participants from each group who completed glucose screening tests in the first 6 months postpartum**

| | Non-reminder group (N = 117) | Reminder group A (N = 90) | Reminder group B (N = 55) |
|---|---|---|---|
| OGTT | 16 (13.7%) | 21 (23.3%) | 20 (36.4%)[a] |
| Random/fasting glucose | 31 (26.5%) | 23 (25.6%) | 12 (21.8%) |
| HbA1c | 16 (13.7%) | 12 (13.3%) | 9 (16.4%) |
| Any glucose test | 44 (37.6%) | 38 (42.2%) | 27 (49.1%) |

Abbreviations: HbA1c, glycated hemoglobin test; N, sample size; OGTT, oral glucose tolerance test; *p*, statistical significance.

[a] $p = .01$, reminder group B vs. non-reminder group.

## Acknowledgements

We would like to thank Sharon Rouatt, Diabetes Educator; Pauline Brazeau-Gravelle, Clinical Dietician; Filamena DeSousa, Diabetes Educator; and Anjie Huang, Statistician. Funding for Alison Shea was provided by the Canadian Institutes of Health Research (CIHR) studentship. Funding for the study was provided by the Obstetrics Maternal & Newborn Investigation (OMNI) research group, The Ottawa Hospital. Dr. Baiju Shah receives salary support from the Canadian Institutes of Health Research, the Canadian Diabetes Association, and the Banting and Best Diabetes Centre of the University of Toronto. No authors have a conflict of interest with this study.

**TABLE 3**

**Adjusted logistic regression models for predicting postpartum glucose screening among women with a history of GDM**

| Outcome | Effect | Adjusted OR | 95% CI | *p*-value |
|---|---|---|---|---|
| OGTT | | | | |
| | Site | | | .029 |
| | Reminder A vs. non-reminder | 1.57 | 0.66 – 3.70 | |
| | Reminder B vs. non-reminder | 3.10 | 1.35 – 7.14 | |
| | Age | | | .262 |
| | < 30 vs. ≥ 40 years | 2.51 | 0.58 –10.83 | |
| | 30–39 vs. ≥ 40 years | 3.06 | 0.79 –11.84 | |
| | Prior GDM | 0.49 | 0.20 – 1.23 | .131 |
| | BMI | | | .134 |
| | Normal vs. obese | 2.42 | 0.92 – 6.36 | |
| | Overweight vs. obese | 3.30 | 1.20 – 9.06 | |
| | GDM treatment | | | |
| | Diet vs. insulin | 0.38 | 0.18 – 0.80 | .012 |
| | Family Hx T2DM | 1.07 | 0.55 – 2.05 | .845 |
| | SES quintiles | | | .635 |
| | 1 (lowest) vs. 5 (highest) | 0.89 | 0.29 – 2.63 | |
| | 2 vs. 5 | 0.96 | 0.33 – 2.84 | |
| | 3 vs. 5 | 0.85 | 0.29 – 2.47 | |
| | 4 vs. 5 | 1.68 | 0.59 – 4.77 | |
| Any test | | | | |
| | Site | | | .734 |
| | Reminder A vs. non-reminder | 1.09 | 0.56 – 2.13 | |
| | Reminder B vs. non-reminder | 1.33 | 0.65 – 2.71 | |
| | Age | | | .595 |
| | < 30 vs. ≥ 40 years | 0.74 | 0.28 – 1.98 | |
| | 30–39 vs. ≥ 40 years | 1.05 | 0.44 – 2.49 | |
| | Prior GDM | 0.68 | 0.35 – 1.34 | .264 |
| | BMI | | | .032 |
| | Normal vs. obese | 2.40 | 1.16 – 5.01 | |
| | Overweight vs. obese | 3.10 | 1.42 – 6.77 | |
| | GDM treatment | | | |
| | Diet vs. insulin | 0.60 | 0.32 – 1.12 | .107 |
| | Family Hx T2DM | 0.77 | 0.45 – 1.31 | .328 |
| | SES quintiles | | | .195 |
| | 1 (lowest) vs. 5 (highest) | 0.92 | 0.38 – 2.21 | |
| | 2 vs. highest | 1.33 | 0.54 – 3.31 | |
| | 3 vs. highest | 0.85 | 0.35 – 2.04 | |
| | 4 vs. highest | 2.09 | 0.85 – 5.13 | |

Abbreviations: BMI, body mass index; CI, confidence interval; GDM, gestational diabetes mellitus; Hx, medical history; OGTT, oral glucose tolerance test; OR, odds ratio; SES, socio-economic status; T2DM, type 2 diabetes mellitus.

Notes: The category listed first on each line represents the reference group.

## References


1. Dyck R, Klomp H, Tan LK, Turnell RW, Boctor MA. A comparison of rates, risk factors, and outcomes of gestational diabetes between aboriginal and non-aboriginal women in the Saskatoon health district. Diabetes Care. 2002;25:487-93.

2. Rodrigues S, Robinson E, Gray-Donald K. Prevalence of gestational diabetes mellitus among James Bay Cree women in northern Quebec. CMAJ. 1999;160:1293-97.

3. Feig DS, Zinman B, Wang X, Hux JE. Risk of development of diabetes mellitus after diagnosis of gestational diabetes. CMAJ. 2008;179:229-34.

4. Kim C, Newton KM, Knopp RH. Gestational diabetes and the incidence of type 2 diabetes: a systematic review. Diabetes Care. 2002;25:1862-68.

5. Retnakaran R, Qi Y, Sermer M, Connelly PW, Hanley AJ, Zinman B. Glucose intolerance in pregnancy and future risk of pre-diabetes or diabetes. Diabetes Care. 2008;31:2026-31.

6. Bellamy L, Casas JP, Hingorani AD, Williams D. Type 2 diabetes mellitus after gestational diabetes: a systematic review and meta-analysis. Lancet. 2009;373:1773-9.

7. Canadian Diabetes Association Clinical Practice Guidelines Expert Committee. Canadian Diabetes Association 2008 clinical practice guidelines for the prevention and management of diabetes in Canada. Can J Diabetes. 2008;32 Suppl 1:S1-S201.

8. Metzger BE, Buchanan TA, Coustan DR, de Leiva A, Dunger DB, Hadden DR, Hod M, Kitzmiller JL, Kjos SL, Oats JN, Pettitt DJ, Sacks DA, Zoupas C. Summary and recommendations of the Fifth International Workshop-Conference on Gestational Diabetes Mellitus. Diabetes Care. 2007;30 Suppl 2:S251-60.

9. Reinblatt SL, Morin L, Meltzer SJ. The importance of a postpartum 75 g oral glucose tolerance test in women with gestational diabetes. J Obstet Gynaecol Can. 2006;28:690-4.

10. Ogonowski J, Miazgowski T. The prevalence of 6 weeks postpartum abnormal glucose tolerance in Caucasian women with gestational diabetes. Diabetes Res Clin Pract. 2009;84:239-44.

11. Retnakaran R, Qi Y, Sermer M, Connelly PW, Zinman B, Hanley AJ. Comparison of National Diabetes Data Group and American Diabetes Association diagnostic criteria for gestational diabetes in their identification of postpartum risk of glucose intolerance. Diabetes Res Clin Pract. 2009;85:40-6.

12. Clark HD, van Walraven C, Code C, Karovitch A, Keely E. Did publication of a clinical practice guideline recommendation to screen for type 2 diabetes in women with gestational diabetes change practice? Diabetes Care. 2003;26:265-8.

13. Dietz PM, Vesco KK, Callaghan WM, Bachman DJ, Bruce FC, Berg CJ, England LJ, Hornbrook MC. Postpartum screening for diabetes after a gestational diabetes mellitus-affected pregnancy. Obstet Gynecol. 2008;112:868-74.

14. Smirnakis KV, Chasan-Taber L, Wolf M, Markenson G, Ecker JL, Thadhani R. Postpartum diabetes screening in women with a history of gestational diabetes. Obstet Gynecol. 2005;106:1297-303.

15. Bentley-Lewis R, Levkoff S, Stuebe A, Seely EW. Gestational diabetes mellitus: postpartum opportunities for the diagnosis and prevention of type 2 diabetes mellitus. Nat Clin Pract Endocrinol Metab. 2008;4:552-8.

16. Clark HD, Graham ID, Karovitch A, Keely EJ. Do postal reminders increase postpartum screening of diabetes mellitus in women with gestational diabetes mellitus? A randomized controlled trial. Am J Obstet Gynecol. 2009;200:634.e1-7.

17. Wilson SE, Lipscombe LL, Rosella LC, Manuel DG. Trends in laboratory testing for diabetes in Ontario, Canada 1995-2005: a population-based study. BMC Health Serv Res. 2009;9:41.

18. Ferrara A, Peng T, Kim C. Trends in postpartum diabetes screening and subsequent diabetes and impaired fasting glucose among women with histories of gestational diabetes mellitus: a report from the Translating Research Into Action for Diabetes (TRIAD) Study. Diabetes Care. 2009;32:269-74.

19. Ratner RE, Christophi CA, Metzger BE, Dabelea D, Bennett PH, Pi-Sunyer X, Fowler S, Kahn SE; Diabetes Prevention Program Research Group. Prevention of diabetes in women with a history of gestational diabetes: effects of metformin and lifestyle interventions. J Clin Endocrinol Metab. 2008;93:4774-9.

20. Ratner RE. Prevention of type 2 diabetes in women with previous gestational diabetes. Diabetes Care. 2007;30:S242-5.

21. Xiang AH, Peters RK, Kjos SL, Marroquin A, Goico J, Ochoa C, Kawakubo M, Buchanan TA. Effect of pioglitazone on pancreatic beta-cell function and diabetes risk in Hispanic women with prior gestational diabetes. Diabetes. 2006;55:517-22.

22. Buchanan TA, Xiang AH, Peters RK, Kjos SL, Marroquin A, Goico J, Ochoa C, Tan S, Berkowitz K, Hodis HN, Azen SP. Preservation of pancreatic beta-cell function and prevention of type 2 diabetes by pharmacological treatment of insulin resistance in high-risk Hispanic women. Diabetes. 2002;51:2796-803.

23. Kim C, Tabaei BP, Burke R, McEwen LN, Lash RW, Johnson SL, Schwartz KL, Bernstein SJ, Herman WH. Missed opportunities for type 2 diabetes mellitus screening among women with a history of gestational diabetes mellitus. Am J Public Health. 2006;96:1643-8.

24. Greenberg LR, Moore TR, Murphy H. Gestational diabetes mellitus: antenatal variables as predictors of postpartum glucose intolerance. Obstet Gynecol. 1995;86:97-101.

25. Hunt KJ, Conway DL. Who returns for postpartum glucose screening following gestational diabetes mellitus? Am J Obstet Gynecol. 2008;198:404.e1-6.

# The development of community health indicators: a district-wide approach

*M. W. Russell, MHA (1); L. A. Campbell, MSc (2); S. Kisely, MD, PhD (3); D. Persaud, PhD (4)*

## Abstract

**Introduction:** In response to high rates of chronic disease, the Capital District Health Authority in Nova Scotia recognized a need to move from a focus on acute care in decision making to one that also values a population health approach guided by community health indicators.

**Methods:** Stakeholders were surveyed on the choice, knowledge and utility of selected indicators.

**Results:** Respondents reported high scores for changes in their knowledge and attitude regarding community health indicators, and identified priority indicators for action. Decision makers' use of community health indicators was increased by stakeholder involvement, supporting evidence in plain language, and wide dissemination.

***Keywords:*** *community health indicators, district hospitals, community health planning, population health, Nova Scotia*

## Introduction

Compared to other Canadians, Nova Scotians have poor health status and high rates of chronic disease and obesity, as well as an aging population.[1,2] Interventions to improve health status require multi-level, multi-sectoral action.[3] For the health system this means moving the focus from acute care to a population health approach, which involves developing partnerships beyond the traditional health care sector and systematically measuring the progress of population health initiatives. Such a strategy may require district health authorities to reassess skill mix, decision support systems, budget allocations, and advocacy priorities as well as to shift to an organizational culture that values a population approach to health.

The Capital District Health Authority (Capital Health) is Nova Scotia's largest provider of health services, providing care to an immediate catchment area of 400 000 (approximately 40% of the population of Nova Scotia). Capital Health operates hospitals, health centres and community-based programs throughout Halifax Regional Municipality and the western part of Hants County, which includes some of the highest population density areas in the province as well as rural areas, small villages, and towns.

Capital Health has a budget of approximately $800 million and a staff of about 11 000 employees and physicians, and is affiliated with Dalhousie University. It serves as a provincial and Maritime referral centre for tertiary and quaternary care. Capital Health has embarked on the implementation of a new strategic plan (QUEST, the planning initiative leading to Our Promise, the new strategic plan). One of the goals of this process is to ensure that its strategic directions are population based and evidence informed. Specifically, achieving the strategic direction of sustainability requires the monitoring of the health of the community by means of locally relevant evidence-informed community health indicators that provide the evidence necessary to support decision making (whether strategic, business, or program). That these core indictors are locally relevant is more important than their being nationally comparable.[4]

Currently, Capital Health reports and takes action to improve acute care based on clinical indicators such as wait times for hip and knee surgery, length of time spent in the emergency department, infection rates and medication errors. However, Capital Health does not have, as yet, a similar systematic review process for improving population health; nor does it systematically use evidence-informed community health indicators to guide decision making. It also has lower than desired rates in preventive health areas such as mammography screening and physical activity.[5,6]

## Methods

The Population Health Committee, set up by Capital Health's Board of Directors, established a working group to recommend community health indicators for Capital Health to monitor. Members of this working group included the Medical Officer of Health, the Director of Planning and Quality (now Performance Excellence), the Head of Community Health and Epidemiology, an epidemiologist from the Health Outcomes Research Unit, a decision support analyst and the Director of Community Health (chair). The group built upon previous organizational work in the area, since utilizing change management evidence that indicates use of existing resources and systems increases the likelihood of acceptance of the change.[7]

**Author references:**

1. Community Health, Capital Health, Halifax, Nova Scotia, Canada
2. Capital Health and Dalhousie University, Halifax, Nova Scotia, Canada
3. University of Queensland and Health LinQ, Brisbane, Queensland, Australia
4. School of Health Administration, Dalhousie University, Halifax, Nova Scotia, Canada

**Correspondence:** Mary W. Russell, Director, Community Health, Capital Health, 3825 Joseph Howe Drive, Halifax, Nova Scotia B3L 4R6; Tel.: (902) 487-0569; Fax: (902) 455-3531; Email: Mary.russell@cdha.nshealth.ca

Because of the district's limited resources and the length of time necessary to change population health, the working group took a pragmatic approach to identifying a manageable number of indicators for Capital Health to monitor on an ongoing basis and a subset of indicators for priority action. In doing so, the working group adopted a four-step process to develop the community health indicators, based in part on the Canadian Institute for Health Information (CIHI) framework for indicator identification.[8] The steps consisted of gathering information to develop an initial set of indicators for monitoring purposes; consulting with stakeholders to identify priority indicators for immediate action; validating the priority indicators; and using the selected indicators (Figure 1). A logic model (Figure 2) shows the interrelating process steps (the activities) and the inputs, outputs and outcomes.

In the first—information gathering—step, the working group considered emerging health issues and priorities using key age groups (general, infants/children, youth, adults, and seniors) to guide thinking in order to select an initial set of indicators. Indicators were organized by age group for three main reasons: community health and health promotion interventions are implemented differently by age group; children's services are delivered mainly by the IWK Health Centre, and such a breakdown assisted in identifying their role in taking action to improve population health; and practitioners working with specific populations would more readily see the application of the indicators to their work.

The group developed criteria to guide selection of the indicators based on a literature review and environmental scan. Critical to selection was local relevance, since the purpose of the chosen indicators was to help guide Capital Health's future business decisions. Further, they had to be consistent with the definition of a good indicator as provided by Accreditation Canada (meaningful and relevant to those using the indicator; collected consistently and accurately without significant additional burden; follows standard definition; rate-based; and aligns with organizational goals and objectives).[9] The committee adapted the screening criteria for indicator selection developed by Saskatchewan Health[10] because this framework is closely aligned with the values and objectives of our working group. The committee also considered the ability to compare Capital Health rates with provincial and national rates over time, in keeping with the strategy recommended by the National Consensus Conference on Population Health Indicators convened by the CIHI.[8]

The working group used the following criteria for indicator selection: linked to one or more of the strategic priorities of Capital Health, actionable by Capital Health, feasible to measure and report, evidence based, easily understood and easy to use, reliable and valid, sensitive and specific, and comparable across jurisdictions and over time (Table 1). The working group also considered it important to identify both positive and negative indicators that would measure the activity and progress of community health strategies within the district, provide a balanced view of the health of the population across program areas and objectives, have minimal duplication, and be ethically and legally measurable.[8,10]

During the second step—consultation—the list of indicators was refined through consultation with district health authority and community stakeholders using a modified Delphi method. This is a structured process for collecting and distilling knowledge from informants through a series of questionnaires interspersed with feedback.[11,12] It has the advantage of gathering opinion without the need for face-to-face meetings. The working group developed an information package for stakeholders consisting of a list of indicators, a brief memorandum outlining the process and goals of the selection process, and a short questionnaire soliciting the stakeholders' knowledge of and the utility of community health indicators using 5-point Likert scales (not aware to very aware, and not helpful to very helpful, respectively). The indicators were organized by age group and presented along with the definition, a brief rationale providing the link between the indicator and health in lay language, comparisons of district-level data to provincial and national figures using the most current available rates, the data sources, and a brief demographic profile of Capital Health.

Stakeholders were asked to identify two priority indicators for each age group. They were also asked if the working group had identified the most relevant indicators, what indicators were missing and should any indicators be deleted. Respondents could choose to reply anonymously.

In addition to distributing the package, the chair of the working group presented the information to small group sessions of stakeholders. The goal of this multi-faceted approach (information package, supporting data, presentation and discussion) was to improve both the response rates and utilization of the indicators.

**FIGURE 1**
**Process methodology**

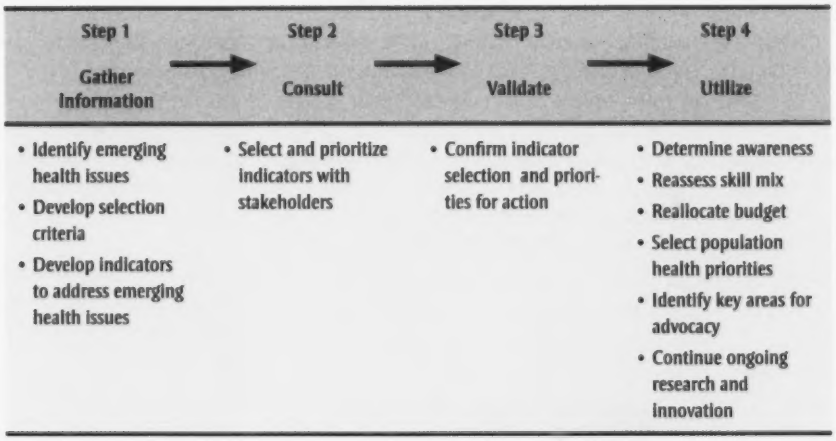


**FIGURE 2**
**Community health indicator logic model**

The following logic model links steps 1-4 from the process methodology logic model (Figure 1) with the inputs, outputs and measures to achieve the outcomes.

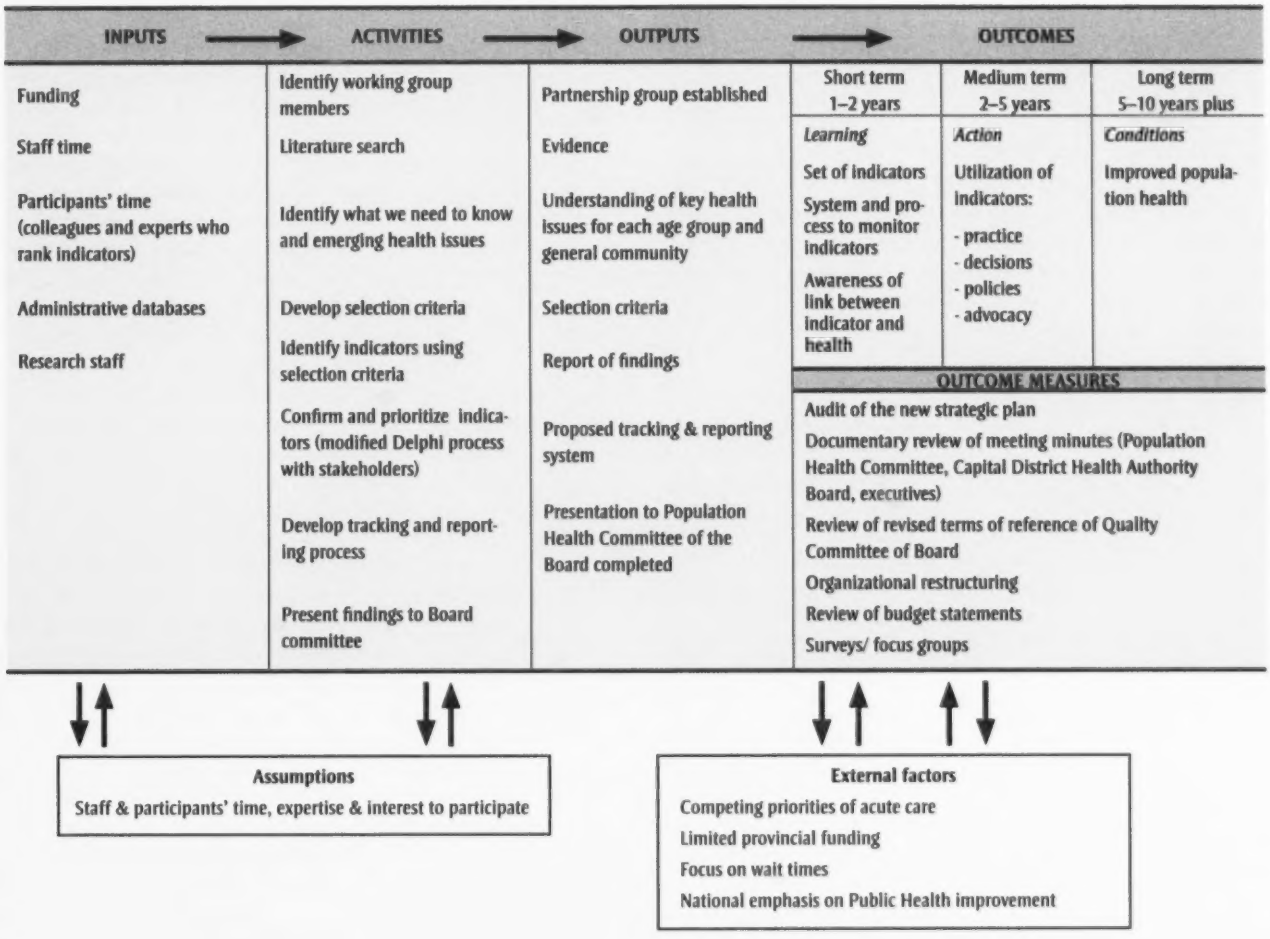

INPUTS
ACTIVITIES
OUTPUTS
OUTCOMES
Funding
Staff time
Participants' time (colleagues and experts who rank indicators)
Administrative databases
Research staff
Identify working group members
Literature search
Identify what we need to know and emerging health issues
Develop selection criteria
Identify indicators using selection criteria
Confirm and prioritize indicators (modified Delphi process with stakeholders)
Develop tracking and reporting process
Present findings to Board committee
Partnership group established
Evidence
Understanding of key health issues for each age group and general community
Selection criteria
Report of findings
Proposed tracking & reporting system
Presentation to Population Health Committee of the Board completed
Short term 1–2 years
Medium term 2–5 years
Long term 5–10 years plus
Learning
Set of indicators
System and process to monitor indicators
Awareness of link between indicator and health
Action
Utilization of indicators:
- practice
- decisions
- policies
- advocacy
Conditions
Improved population health
OUTCOME MEASURES
Audit of the new strategic plan
Documentary review of meeting minutes (Population Health Committee, Capital District Health Authority Board, executives)
Review of revised terms of reference of Quality Committee of Board
Organizational restructuring
Review of budget statements
Surveys/ focus groups
Assumptions
Staff & participants' time, expertise & interest to participate
External factors
Competing priorities of acute care
Limited provincial funding
Focus on wait times
National emphasis on Public Health improvement

**TABLE 1**
**Health indicator selection criteria**

| Criteria | Definition |
|---|---|
| Linked to one or more of the strategic priorities of Capital Health | What is measured may influence or play a role in the refinement of the district's strategic priorities |
| Actionable by Capital Health | Capital Health can influence a change (via advocacy, partnership, or direct intervention) |
| Feasible to measure and report | Measurable in a practical, cost-efficient way, and derived from available/accessible management information systems |
| Evidence based | Evidence linking a change in indicator to improved health outcomes |
| Easily understood/used | Easy to understand by intended users (the Board, senior leadership team, staff) |
| Reliable and valid | Scientifically sound, measured consistently (reliability) and accurately (validity) |
| Sensitive and specific | Responsive to action; readily responds to external stimuli and has a distinct effect |
| Comparable | Comparable across jurisdictions (e.g. other District Health Authorities, provinces, nationally) and over time |

Adapted from: Saskatchewan Health Regional Health Services (2007)[10]

**TABLE 2**
**Priority indicators per category and identification response rates**

| Category | Indicator | Responses (%) |
|---|---|---|
| General | Poverty | 31.6 |
| | Food insecurity | 21.1 |
| | Housing affordability | 15.8 |
| | Environment/regular physician/ unemployment | 10.5 |
| Infant/Children (0–11 years) | Breastfeeding initiation | 25.0 |
| | Early childhood development | 23.5 |
| | Exposure to second hand smoke | 20.6 |
| | MMR immunization | 10.3 |
| Youth (12–19 years) | Overweight/obesity[a] | 32.8 |
| | Physical inactivity | 23.4 |
| | Smoking | 17.2 |
| | Sexually transmitted infections | 10.9 |
| Adults (20–64 years) | Overweight/obesity[a] | 31.7 |
| | Literacy | 19.0 |
| | Physical inactivity | 12.7 |
| | Colorectal screening | 9.5 |
| Older Adults (65+ years) | Home care wait times | 36.8 |
| | Physical inactivity | 31.6 |
| | Falls | 19.3 |
| | Influenza immunization | 12.3 |

Abbreviations: MMR, Measles, mumps and rubella vaccine.
Notes: Table includes the top four priority indicators in each area due to space limitations.
[a] Overweight and obesity were initially separate, but were combined for practical purposes.

The third step in the process was the validation step. Upon receipt of initial stakeholder feedback, the indicators and priorities for action chosen by stakeholders was confirmed and planned for, by means of further consultation sessions with stakeholders if necessary.

The final step, currently underway, involves the utilization of the indicators to measure population health including reassessment of skill mix and reallocation of the budget. It also permits the identification of key areas for advocacy, as well as innovation in health care practice across service delivery and research.

## Results

### *Selection of indicators*

The working group selected 53 initial indicators and sent this list to key stakeholders. Of the 59 stakeholders surveyed, 38 responded (64% response rate). The top priorities for action identified for each group were as follows: the population in general—the percentage of low-income families (32%); infants and children—the percentage of mothers breastfeeding on leaving hospital (25%); youth—the percentage who are overweight or obese (with body mass index [BMI] greater than or equal to 25 kg/m$^2$) (33%); adult—the percentage who are overweight or obese (32%); adults over 65 years old—home care wait times (37%). There was reasonably good agreement for priority indicators for each of the age groups (Table 2). Generally, indicators chosen for priority action were those for which there was good evidence of need as indicated by the additional data and information provided to the respondents.

Respondents showed high scores for knowledge and attitudes on the Likert scales (medians of 4) in response to the questions, "On a scale of 1 to 5, has the information provided and discussions through QUEST increased your awareness of the health status of our community and the link between the indicator and health?" and "On a scale of 1 to 5, do you think monitoring and reporting these indicators would help guide the Board and organization in its strategic and business decision-making?" Unfortunately, there were no baseline data with which to compare these self-report scores. With respect to increasing awareness of the health status of the community and the link between the indicator and health, 73% of the respondents indicated that the information provided improved their awareness and 94% reported that they thought monitoring and reporting these indicators would help guide the Board and the organization in its strategic and business decision-making.

Further prioritization/validation sessions with stakeholders had been planned as the third step in the process in the event of lack of consensus in the consultation step. However, the results indicated consensus regarding priorities for initial action. Therefore, wider dissemination was planned following presentation to the Population Health Committee of the Board.

Survey results regarding priority indicators for district action were presented to the Population Health Committee of the Board for their consideration and utilization. Due to limited resources, the Committee supported one priority indicator (physical inactivity), which was the second most important issue for the youth and older adult age groups and the third most important for the adult age group. As a result, a strategy with specific targets to increase physical activity levels was developed to demonstrate how a partnership approach can be used to improve community health,

as measured by indicators. However, recognizing the importance of the relationship between poverty, health and access to services, the Population Health Committee suggested further exploration of the role of the district in addressing poverty following a review of the provincial Poverty Reduction Strategy.[13]

*Monitoring of indicators*

The working group recommended a process for ongoing monitoring and reporting of the full set of community health indicators that involved the integration of the tracking and reporting process at both strategic and operational levels, with monitoring of the indicators and annual reporting on progress completed by a single group that includes an epidemiologist, health economist, data analyst and others as necessary.

The working group also recommended development of a concise, easy-to-read "dashboard" report that contains key indicators to support decision making at Board level. Supporting material would be made available upon request. The Population Health Committee would receive and discuss the dashboard reports, and make recommendations for health improvement strategies to the Board in response to these. The Quality Committee of the Board should also receive the indicator reports for its information. This Committee currently monitors mainly acute care indicators but has recognized the need to consider the impact of broad community health indicators on their work. Importantly, it was also recommended that the annual dashboard report be made available to the broader community. It is recognized that these indicators reflect highly complex issues that will require time and effort to change. The Population Health Committee noted that it would be helpful to monitor and report changes to predisposing factors that would be expected to impact the selected indicators as part of the monitoring strategy.

## Discussion

District health authorities are legislated to "improve the health of their communities." The boards of district health authorities make decisions based on information provided to them. Providing boards with evidence of the link between community health indicators and health outcomes, and the need for "upstream," multi-level, multisectoral action, as demonstrated through this intervention project, has implications for a range of actions. These include the selection of actionable population health priorities, reallocation of budget from acute care to population health, reassessing skill mix needed to take action to improve the indicators (e.g. epidemiologists, health economists, analysts, public health personnel), identification of key areas for advocacy, determining areas for innovation and research related to population health (evaluation of effective interventions to increase physical activity in the district), and shifting organizational culture to include valuing a population approach to health.

Change management theory indicates that the first step in changing behaviour is to increase awareness of the issue. It was hoped that the evidence provided through the presentations and discussions, along with the information package material, would lead to an increased stakeholder awareness of the need to develop and subsequently use community health indicators in decision making and of the need to move from a system focused on acute care to one that also values a broad population health approach. The stakeholders were influential, directly or indirectly, in identifying the need to include community health indicators in our business and strategic plans.[14]

At the board and executive level, building capacity for evidence-informed decision making related to population health has implications for business and strategic planning. It can assist an organization to better determine where and how to allocate resources. The evidence helps identify the areas of greatest need and where interventions are likely to succeed, and hence quality information is required in order to set priorities. The identification of community health priorities for action allows for focused action by the organization, enabling greater impact.

The working group's method of indicator identification provided evidence-informed information to assist Capital Health in selecting indicators for action. It combined both empirical and contextual evidence through consensus. The utilization of research evidence in decision-making is facilitated if decision makers are aware that it exists (wide dissemination) and is summarized concisely with implications for practice.[15,16] A set of community health indicators is the first step towards this goal. We concluded that the use of population health indicators by decision makers is increased by: (1) involving those who will use the indicators during indicator development; (2) presenting evidence clearly linking indicators to health in an easy-to-manage and useful format and in plain language; and (3) wide dissemination.

Such a process is not without challenges. Selection of too many indicators dilutes the available information and makes the task of monitoring and reporting unmanageable. However, if too few indicators are identified, the overall picture of the health of the population is inaccurate. In addition, our information is derived from a sample with a 64% response rate. Organization of indicators by age group meant that some indicators received greater representation in the selection process. However, the reality of policy development and service delivery by age group outweighed this concern. Finally, some of the indicators chosen in this project, such as the percentage of low-income families in the general population, may not be readily amenable to direct action by Capital Health, though they are important areas for advocacy.

Understanding the community's health status is essential in the development of population-wide strategies for health improvement. This project has provided community health indicators to monitor planning and performance for population health improvement. As local health data are important for local health planning, Capital Health is completing a district health assessment adapted from the Canadian Community Health Survey to obtain health data at the community health board level. Local data assist in mobilizing communities to action. The process for determining these indicators, as described here, may help other district health authorities meet their legislative mandate of improving the health of their communities.

This project has implications beyond the district level by providing evidence for the districts and community health boards to advocate for further provincial investment in policies and practices that reduce social, economic and health inequalities. Ultimately, a scorecard or dashboard on community health indicators will be available to the community, permitting transparency and accountability. It will assist the community in gaining a better understanding of the health of their community.

Identifying what contributes to a healthy community is still not well understood by district health authorities. Researchers may be interested in implementing and evaluating population health initiatives for which there are no current data or evidence of effective interventions. This will add to the body of knowledge in this area. It would be particularly interesting in future endeavours to implement these indicators across district health authorities in Nova Scotia and compare their effectiveness in supporting community and stakeholder action to address chronic diseases.

## Acknowledgements

Mary Russell held a fellowship with the Executive Training for Research Application (EXTRA) Program, 2006–2008. This project was completed under the supervision of mentors Dr. Stephen Kisely, Dr. David Persaud and Patrick Lee in partial fulfillment of the fellowship requirements. Support for the project was provided by the Decision Support and Health Outcomes Research Units, Capital Health. The authors wish to acknowledge the contributions of Dr. Ed Kinley, Chair of the Population Health Committee, and the members of the original community health working group: Mr. Mike Kivell, Ms. Kathleen Martin, and Dr. Gaynor Watson-Creed.

## References

1. Canadian Cancer Society's Steering Committee. Canadian cancer statistics 2009. Toronto (ON): Canadian Cancer Society; 2009 Apr. 127 p. ISSN 0835-2976.

2. Hayward K, Colman R. The tides of change: addressing inequity and chronic disease in Atlantic Canada: a discussion paper [Internet]. Halifax (NS): Health Canada; 2003 Jul [cited 2009 Jul 6]. 139 p. Available from: http://www.phac-aspc.gc.ca/canada/regions/atlantic/pdf/Tides_Inequity_and_Chronic_Disease.pdf

3. Dalhousie University, Unit for Population Health and Chronic Disease Prevention. Nova Scotia chronic disease prevention strategy [Internet]. Halifax (NS): Department of Health Promotion and Protection; 2003 Oct 31 [cited 2009 Jul 15]. 50 p. Available from: http://www.gov.ns.ca/hpp/publications/CDP_Strategy_Report_Final_October30.pdf

4. Hancock T, Labonte R, Edwards R. Indicators that count! Measuring population health at the community level. Can J Public Health. 1999; 90 (Suppl 1):S22-S26.

5. Nova Scotia Breast Screening Program. Nova Scotia Breast Screening Program annual report 2008 (2007 Data) [Internet]. Halifax (NS): Nova Scotia Breast Screening Program 2008 Dec 18 [cited 2009 July 15]. 62 p. Available from: www.breastscreening.ns.ca/webReport08/webReport.html

6. Statistics Canada. Canadian Community Health Survey, Cycle 3.1, 2005, CANSIM table 105-0433 [Internet]. [cited July 15 2009] Available from: http://cansim2.statcan.gc.ca/cgi-win/cnsmcgi.pgm?regtkt=&C2Sub=&ARRAYID=1050433&C2DB=PRD&VEC=&LANG=E&SrchVer=2&ChunkSize=50&SDDSLOC=&ROOTDIR=CII/&RESULTTEMPLATE=CII/CII_PICK&ARRAY_PICK=1&SDDSID=&SDDSDESC=

7. Reay T, Golden-Biddle K, Germann K. Legitimizing a new role: small wins and microprocesses of change. Acad Manage J. 2006; 49(5):977-98.

8. Canadian Institute for Health Information. National consensus conference on population health indicators: final report. Ottawa (ON): Canadian Institute for Health Information; 1999 36 p. ISBN 1-895581-56-7.

9. Canadian Council on Health Services Accreditation (now Accreditation Canada). CCHSA's accreditation program: indicators, 2nd ed. Ottawa (ON): Canadian Council on Health Services Accreditation; 2003. 88 p. ISBN 1-55149-050-1.

10. Saskatchewan Health Regional Health Services. Policy and procedure manual: performance management accountability indicators [Internet]. Saskatchewan: Saskatchewan Health; 2007 May 30 [cited 2009 July 10] 274 p. Available from: http://www.health.gov.sk.ca/performance-accountability-06/07

11. Adler M, Ziglio E, editors. Gazing into the oracle: the Delphi method and its application to social policy and public health. Briston (PA): Jessica Kingsley Publishers; 1996. 264 p.

12. Linstone HA, Turoff M, editors. The Delphi method: techniques and applications. Reading (MA): Addison Wesley; 1975. 620 p.

13. Province of Nova Scotia. Preventing Poverty Promoting Prosperity. Nova Scotia's Poverty Reduction Strategy [Internet]. Nova Scotia: Province of Nova Scotia; 2009 [cited 2010 Oct 18]. Available from: http://www.gov.ns.ca/coms/specials/poverty/documents/poverty_report_2009.pdf

14. Capital Health. Our Promise Strategy [Internet]. Halifax (NS): Capital Health; 2008 April [cited 2010 Oct 18]. Available from: http://ourpromise.ca/wp-content/uploads/2007/12/Our_Promise_Strategy.pdf

15. Kovner AR, Rundall TG. Evidence-based management reconsidered. Front Health Serv Manage. 2006;22(3):3-22.

16. Pyra, K. Knowledge translation: a review of the literature. Halifax (NS): Nova Scotia Health Research Foundation. 2003 Oct.

# Projection of future cancer incidence and new cancer cases in Manitoba, 2006–2025

*J. Nowatzki, MSc (1); B. Moller, PhD (2); A. Demers, PhD (1,3)*

## Abstract

**Introduction**: Projecting the burden of cancer is important for evaluating prevention strategies and for administrative planning at cancer facilities.

**Methods**: We projected cancer incidence and counts for the population of Manitoba using population projections from the Manitoba Bureau of Statistics for the years 2006 to 2025 and cancer incidence data from the Manitoba Cancer Registry for the years 1976 to 2005. Data were analyzed using a version of the age-period-cohort model with recommended modifications that was developed and tested in the Nordic countries.

**Results**: The overall incidence of cancer in Manitoba is not projected to change substantially from 2006 to 2025. However, the age-standardized incidence for lung cancer is expected to decrease, particularly for males, highlighting the importance of tobacco prevention. The total number of new cancer cases per year is expected to increase 36% over the projection period, attributable primarily to demographic changes.

**Conclusion**: As the population of Manitoba increases, resource and infrastructure planning will need to account for the expected increase in cancer cases.

***Keywords:*** *cancer, projections, incidence, burden of disease, Manitoba*

## Introduction

Projection estimates of the burden of cancer have significant implications. They are important for administrative planning at cancer facilities, including establishing future policy and research plans. Projections also have scientific implications; by comparing projected numbers to actual cancer outcomes, they can be used as a benchmark against which to evaluate prevention strategies.[1] In this case, age-standardised rates allow comparison of cancer incidence across populations on a per capita basis.

Projecting cancer rates is challenging because many risk factors have not been identified; for known risk factors, it is difficult to directly measure exposure and impact. Further, changes in prevention and cancer care that may have a significant impact on incidence or mortality are unpredictable. Various statistical methods have been used to project cancer incidence in other countries.[2-7] The most common cancer projection models use trends in the three time-related variables of age, period and birth cohort as a substitute measurement of the risks associated with cancer incidence and mortality.[1,4,5] Future rates are predicted by extrapolating from historical trends in the proxy variables of age, period and cohort. Linear changes in cancer incidence across particular age groups, time periods or generations (cohorts) will likely continue for some time, and this is the major assumption made in age-period-cohort modelling. Because only linear changes in the proxy variables can be extended into the future to make predictions, cancer projections are subject to a great deal of uncertainty.

Moller et al. proposed a method for long-term projection of cancer incidence using age-period-cohort modelling after comparing several versions of the model on data from the Nordic countries.[8] The researchers tested a total of 15 models by comparing predictions based on prior historical data to observed rates, and recommended those models that produced the most accurate predictions. These tested and recommended techniques have been used to project cancer in the Nordic countries[4] and in England[5] but have not been used widely in Canada.[9] Projections for all cancers combined in the Nordic countries (1998–2002 to 2018–2022) suggest that rates have levelled off for males and will level off for females about ten years from the start of the projection period.[4] Results from projections in England (2004–2020) suggest that incidence of all cancers combined for males may now be starting to decrease after increasing over the past few decades; similarly, incidence of all cancers combined for females are projected to start decreasing in 2015.[5]

The purpose of this paper is to present the results of applying recommended projection methods to the population of Manitoba, Canada, for the period 2006 to 2025. The resulting estimates of the number of new cancer patients in Manitoba over the projection period will help plan for future healthcare needs related to cancer. Further, the results will show how current

**Author references:**

1. Epidemiology & Cancer Registry, CancerCare Manitoba, Winnipeg, Manitoba, Canada
2. Clinical and Registry-based Research Department, Cancer Registry of Norway, Oslo, Norway
3. Department of Community Health Sciences, Faculty of Medicine, University of Manitoba, Winnipeg, Manitoba, Canada

**Correspondence:** Janet Nowatzki, Epidemiology & Cancer Registry, CancerCare Manitoba, 409 Tache, Room OG008, Winnipeg, MN R2H 2A6; Tel.: (204) 235-3431; Fax: (204) 231-8188; Email: janet.nowatzki@cancercare.mb.ca

trends may impact future incidence, and projected rates will serve as a reference point against which to measure future cancer control initiatives in Manitoba.

## Methods

### *Data*

We obtained cancer incidence counts from the Manitoba Cancer Registry for the years 1976 to 2005. Data were summarized by sex into 5-year periods (1976–1980, ... 2001–2005) and 5-year age groups (0–4, 5–9, ..., 80–84, 85+) and categorized using codes from both the *International Statistical Classification of Diseases, Ninth Revision* (ICD-9)[10] and *Tenth Revision* (ICD-10).[11] Non-melanoma skin cancers, benign and in situ neoplasms, and those of uncertain behaviour or unspecified nature were excluded from the projections. In order to have enough incident cases to calculate reliable projections, there needed to be at least three age groups to satisfy the condition of having at least 20 cases per period and age group; cancer sites that did not satisfy this requirement were grouped into the category "other." For females, the category "other" included the cancer sites oral cavity and pharynx, esophagus, melanomas of the skin, kidney and renal pelvis, brain and other nervous system, thyroid, Hodgkin's lymphoma and all other and unspecified cancers. For males, the category "other" included the cancer sites esophagus, melanomas of the skin, testis, brain and other nervous system, thyroid, Hodgkin's lymphoma, and all other and unspecified cancers.

Using the Manitoba population projections for 2006 to 2026,[12] we aggregated projected population data from the main projection scenario for the years 2006 to 2025 and actual population data for the years 1976 to 2005 into 5-year periods and 5-year age groups by sex in the same manner in which we summarized the cancer incidence data.

### *Modelling of incidence*

We calculated the projected cancer incidence with NORDPRED[4] in the statistical computing software R version 2.5.0.* Developed at the Norwegian Cancer Registry, NORDPRED is a package for predicting cancer incidence and mortality. The model used is based on the standard age-period-cohort Poisson regression model[13] and can be written as follows:

$$R_{ap} = \exp(A_a + D \cdot p + P_p + C_c)$$

where $R_{ap}$ is the incidence in age group $a$ and period $p$, $A_a$ is the age component for age group $a$, $D$ is the common drift parameter accounting for the linear component of the trend in period and cohort (it is not distinguishable as uniquely a period or a cohort effect[14]), $P_p$ is the nonlinear period component of period $p$, and $C_c$ is the nonlinear cohort component of cohort $c$.

On the recommendation of Moller et al., we modified the model for most cancer sites.[8] When cancer registry data are available for a period of several decades, it is recommended that cancer projections be calculated with the power model.[1] To modify the classic age-period-cohort model in this way, we chose a power link function instead of the logarithmic link function. This change serves to dampen any exponential increase in the rates over time. The model is as follows:

$$R_{ap} = (A_a + D \cdot p + P_p + C_c)^5$$

This modification cut the drift parameter by 0%, 25%, 50%, and 75% in the first, second, third, and fourth 5-year periods respectively, with the intention of gradually decreasing the effect of current trends, since current trends are unlikely to continue at the same rate.

Finally, if there were significant sharp changes in the historical rates, projections based on the entire set of historical rates would be inaccurate. The test for departure from a linear trend consisted of checking the significance of $S$ in the following model:

$$R_{ap} = (A_a + D \cdot p + S \cdot p^2 + C_c)^5$$

In cases where $S$ was significant, we used only the trend in the most recent 10 years to project the drift component. This modification was made for the following cancer sites: lung (males), oral cavity and pharynx (males) and breast (females).

The lower age limit was chosen to insure that the number of cases was greater than 20 in all observation periods for each cancer site. Projections for age groups below this limit were based on average rates in the last 10 years.

Models for observed rates for each cancer site were fit by using the greatest prediction base (between four and six 5-year periods) that satisfied a goodness-of-fit test. The parameters of the model for projected rates were derived as described for the Nordic countries as follows:[4] the age component $A$ was projected directly; the linear drift $D$ was projected with the two modifications described earlier; the nonlinear cohort component $C$ was projected directly for known cohorts and taken to equal the last estimated effect in the model for new cohorts; and the non-linear period component $P$ was taken to equal the last estimated effect in the model for all future periods. Projected incidence was then calculated based on the resulting models.

Spikes in prostate cancer incidence in the late 1980s and the 1990s coincided with the introduction of the prostate-specific antigen (PSA) test, and reflected a screening effect. Using the standard set of assumptions to project prostate cancer would result in projecting a substantial—and unlikely—jump in incidence. With respect to bladder cancer, historical incidence shows a sharp decrease in the last decade because some neoplasms formerly considered invasive bladder cancer were reclassified as in situ neoplasms; in this case, using historical rates would predict a continued sharp decrease that is equally unlikely to occur. Following methods used in Norway and England,[5,15] we used a constant rate model to project both prostate and bladder cancer. The average rates from the most recent time period (2001–2005) were assumed to remain constant throughout the projection period. Therefore, any projected increases in the number of cancer cases for these sites are due to changes in the population.

We calculated the projected rates for all cancers combined for males and for females by summing the projected rates that were calculated for the individual cancer sites, including "other." Age-standardized incidence rates were calculated using the 1991 Canadian standard population.

* www.r-project.org/

We calculated the projected cancer incidence counts by multiplying the projected rates by the projected population in corresponding future periods. The percent change in cancer incidence counts over the projection period was apportioned into the contribution from change in cancer risk and the contribution from change in demographics (size and age of population). The portion of the change due to change in risk was calculated by subtracting the number of cases that would result from multiplying current incidence by the estimated future population from the estimated number of future cases. Similarly, the portion of the change due to change in population was calculated by subtracting the current number of cases from the number of cases that would result by multiplying the current incidence and the estimated future population.[4]

## Results

Table 1 shows the ICD-10[†] codes used to define the cancer sites and the lower limit of the youngest age group included in the projections, the number of 5-year periods used in the prediction base, and whether or not the recent trend from the previous 10 years or the trend over the entire prediction base was used in the projection.

### *Cancer incidence*

Overall, the age-standardized incidence in Manitoba for all cancers combined is predicted to decrease slightly over the projection period, 2006 to 2023 (Figure 1). Figure 2 shows the actual (1976–2005) and projected (2006–2025) age-standardized incidence by cancer sites. For most sites, rates are expected to remain stable over the projection period. The largest changes in incidence expected over the 20-year projection period are decreases in oral cavity and pharynx cancers (−25%) and lung cancers (−32%) among males. Female lung cancer incidence is expected to continue to increase for 5 to 10 years before starting to decrease.

**TABLE 1**
**ICD-10 codes,[a] lower limit of the youngest age group used in the models, number of periods used in the prediction base, and use of recent or average trend in cancer projections, Manitoba**

| Cancer site | ICD-10 codes[a] | Females | | | Males | | |
|---|---|---|---|---|---|---|---|
| | | Lowest age[b] | Number of periods[c] | Average trend[d] or recent trend[e] | Lowest age[b] | Number of periods[c] | Average trend[d] or recent trend[e] |
| Oral cavity and pharynx | C000–C148 | — | — | — | 45 | 6 | Recent |
| Stomach | C16 | 70 | 6 | Average | 55 | 6 | Average |
| Colorectal | C18–C20, C26.0 | 45 | 6 | Average | 40 | 6 | Average |
| Pancreas | C25 | 65 | 6 | Average | 60 | 6 | Average |
| Lung | C34 | 45 | 6 | Average | 45 | 6 | Recent |
| Breast | C50 | 30 | 4 | Recent | — | — | — |
| Cervix uteri | C53 | 30 | 6 | Average | — | — | — |
| Corpus and uterus | C54, C55 | 45 | 6 | Average | — | — | — |
| Ovary | C56 | 45 | 6 | Average | — | — | — |
| Prostate | C61 | — | — | — | — | — | — |
| Urinary bladder | C66–C68 | — | — | — | — | — | — |
| Kidney and renal pelvis | C64, C65 | — | — | — | 50 | 6 | Average |
| Non-Hodgkin's lymphoma | C82–C85, C96.3 | 55 | 6 | Average | 60 | 6 | Average |
| Leukemia | C90.1, C91–C95 | 65 | 6 | Average | 55 | 6 | Average |
| Other[f] | | 15 | 6 | Average | 15 | 6 | Average |

Abbreviations: ICD-10, International Statistical Classification of Diseases and Related Health Problems, 10th Revision; ICD 9, International Statistical Classification of Diseases and Related Health Problems, 9th Revision.

[a] The more recent ICD-10 have been in use since 2002. ICD-10 codes map over easily to ICD-9, and hence only they are shown in Table 1.

[b] Lower limit of youngest age group used in the model.

[c] Number of periods used in the prediction base.

[d] Average trend over entire prediction base.

[e] Average trend from last 10 years used in the model.

[f] Females: C000–C148, C15, C44, C64, C65, C70–73, C81, and all other invasive cancers, not listed here or above (ICD-10: C00–C97). Males: C15, C44, C62, C70–73, C81, and all other invasive cancers, not listed here or above (ICD-10: C00–C97). Our analyses excluded non-melanoma skin cancers.

[†] The more recent ICD-10 codes, in use since 2002, map over easily to the previous ICD-9 codes; hence only they are shown in Table 1.

*Cancer incidence and attributing change*

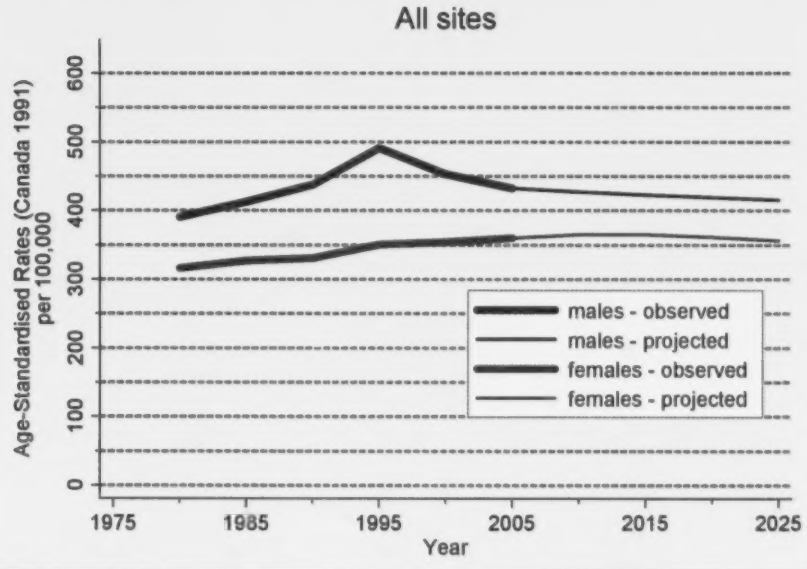
Table 2 summarizes the predicted change in number of cancer cases by site and gender between the midpoint of the last 5-year period of data (2003) and the midpoint of the last 5-year period of the projections (2023). For each cancer site, it shows the percent of the total change that is attributable to change in risk and the percent of the total change that is attributable to change in the size and age of the population. We expect notable decreases in risk of incidence for the following cancers: oral cavity and pharynx (males), stomach (females), colorectal (females), pancreas (males and females), and lung (males). We also expect notable increases in risk for Non-Hodgkin's lymphoma in both males and females. The predicted increases in cancer cases for most cancer sites are largely attributable to demographic changes; the population of Manitoba is expected to grow approximately 22% (1 178 460 in 2006 to 1 439 150 in 2025), largely due to international immigration that is expected to account for more than 80% of the growth in the population over the projection period.[12] Simultaneously, this population is expected to age so that the median age increases by 1.3 years over the projection period.[12] Figure 3 shows the expected changes in the population of Manitoba by age and gender.

Overall, the total number of new cancer cases per year is expected to increase by 36% from approximately 5500 in 2003 to approximately 7500 in 2023. Although the numbers of cancer cases in men and women have been relatively similar in recent years, we expect a greater increase in cancer cases in men (40%) than in women (30%) over the projection period, so that by 2023 there will be 7% more cancer cases in men than in women.

## Discussion

In Manitoba, the incidence of all cancers combined is expected to decrease slightly between 2006 and 2025, similar to the results for England where overall incidence is projected to stabilize and start to decline immediately for men and from 2015 for women.[5] The expected rates for all cancers combined and for the individual sites will provide a benchmark against which to measure the impact of prevention strategies in Manitoba. For example, targeting risk factors such as obesity, physical inactivity and tobacco use may result in incidence lower than that predicted.

**FIGURE 1**
**Actual and projected age-standardised incidence of all cancers combined until 2025, Manitoba**

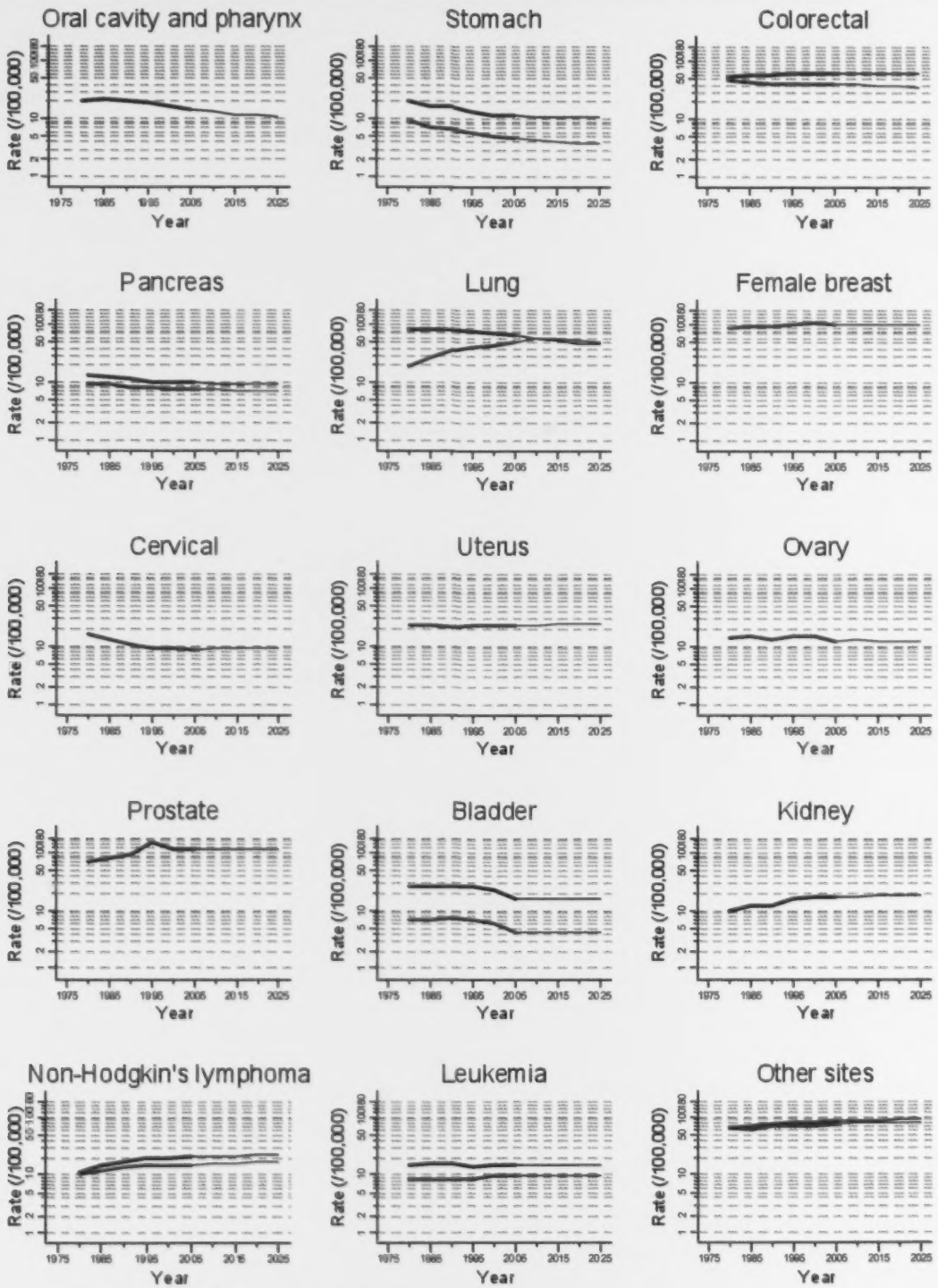



Much like in England, a large part of the stabilization of total cancer incidence in Manitoba is likely due to a reduction in the use of tobacco,[5] the probable reason for the downward trend in lung cancer incidence in Canada.[16] Particularly for men, cancers of the oral cavity and pharynx and lung have been decreasing for the past two decades (see Figure 2) and are expected to continue to decrease over the projection period. Women have historically had lower smoking rates than men, although since the late 1980s, the difference between smoking prevalence in men and women has been quite small. Therefore, lung cancer rates in women have been increasing and are only now reaching the same levels as men's. In turn, the effects from the decreased use of tobacco in women are not expected to be realized for approximately ten years, when lung cancer rates are predicted to begin to decline. Lung cancer currently accounts for approximately 14% of all cancers in Manitoba, though a large portion of other cancers in Manitoba can also be attributed to smoking.[16-18] Since incidence for all cancers combined has been increasing in past decades, a change in the pattern demonstrates the potential impact of primary prevention.

We can expect the number of cancer cases in Manitoba to increase from approximately 5500 to 7500 over the projection period. For most cancers, the majority of this projected change is attributable to the changes in the population. As the population of Manitoba increases and slowly ages, cancer services will need to expand to accommodate the predicted increase in cancer cases. The relative contribution to the total number of cancer cases by each of the four major sites (colorectal, lung, breast and prostate) is not expected to change significantly over the projection period. This information is useful for planning the allocation of future cancer services in Manitoba.

The method used to calculate the current predictions has been shown to be fairly accurate.[8] The discrepancies between actual outcomes and projected numbers in the analysis of the rates in Nordic countries were generally between 10% and 20%. However, the projected rates and counts for all cancers combined are likely more

**FIGURE 2**
**Actual and projected age-standardised incidence of most cancer sites to 2025, Manitoba**




**Notes: Male rates in dark blue; female rates in grey**
Thick lines represent actual rates; thin lines represent projected rates.
Other sites means all cancers excluding non-melanoma skin cancers, benign and in situ neoplasms, and those of uncertain behaviour or unspecified nature.

**TABLE 2**
**Number of predicted cancer cases by site and gender in 2023, Manitoba**

| Cancer site | Females | | | | | Males | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Number of cases | | Percent change (%) | | | Number of cases | | Percent change (%) | | |
| | 2003[a] | 2023[b] | Overall[c] | Due to risk[d] | Due to change in population[e] | 2003[a] | 2023[b] | Overall[c] | Due to risk[d] | Due to change in population[e] |
| Oral Cavity and Pharynx | — | — | — | — | — | 97 | 101 | 3 | −37 | 40 |
| Stomach | 42 | 41 | −1 | −28 | 27 | 77 | 106 | 38 | −6 | 44 |
| Colorectal | 358 | 429 | 20 | −11 | 31 | 409 | 622 | 52 | 7 | 45 |
| Pancreas | 69 | 79 | 15 | −16 | 31 | 65 | 88 | 36 | −10 | 46 |
| Lung | 408 | 568 | 40 | 1 | 39 | 434 | 441 | 2 | −47 | 49 |
| Breast | 776 | 982 | 27 | −4 | 31 | — | — | — | — | — |
| Cervix uteri | 53 | 67 | 28 | 4 | 24 | — | — | — | — | — |
| Corpus and uterus | 175 | 248 | 42 | 7 | 35 | — | — | — | — | — |
| Ovary | 94 | 117 | 24 | −7 | 31 | — | — | — | — | — |
| Prostate | — | — | — | — | — | 703 | 1078 | 53 | 0 | 53 |
| Urinary bladder | 37 | 49 | 33 | 0 | 33 | 106 | 152 | 43 | 0 | 43 |
| Kidney and renal pelvis | — | — | — | — | — | 113 | 169 | 49 | 6 | 43 |
| Non-Hodgkin's lymphoma | 119 | 174 | 45 | 16 | 29 | 132 | 204 | 54 | 13 | 41 |
| Leukemia | 74 | 97 | 31 | 2 | 29 | 96 | 134 | 40 | −2 | 42 |
| Other | 574 | 775 | 35 | 6 | 29 | 537 | 782 | 46 | 6 | 40 |
| All cancers[f] | 2779 | 3625 | 30 | −1 | 31 | 2769 | 3877 | 40 | −6 | 46 |

[a] Average annual incidence as recorded 2001–2005.

[b] Average annual incidence as predicted 2021–2025.

[c] Overall percent change in the number of cases projected for 2021–2025 compared to the actual number of cases 2001–2005.

[d] Percent of the total change in the number of cases projected due to changes in risk.

[e] Percent of the total change in the number of cases projected due to changes in the size and age of the population.

[f] All cancers combined, excluding non-melanoma skin cancers, benign and in situ neoplasms, and those of uncertain behaviour or unspecified nature; totals are a combination of counts and proportions from individual cancer sites.

accurate than those for individual sites, as the variation from individual sites will likely cancel out or stabilize when sites are combined into one category.

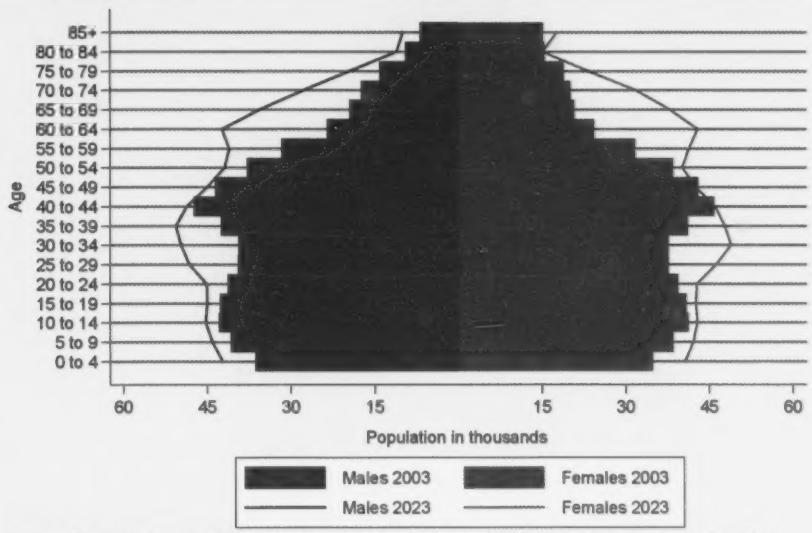
The constant rate model was chosen to predict prostate and bladder cancer incidence to better control for short temporal variations in rates breaking away from the general trend. For prostate cancer, it is important to acknowledge that future trends are subject to uncertainty and may depend in part on future use of the PSA test.

*Limitations*

Although the method developed in the Nordic countries is recommended for cancer projections, it is not without limitations. First, the projected rates are based on the assumption that past trends will continue into the future. Any changes in these trends will mean that the projections will not be realized. This is always the case when attempting to predict future events involving uncertainty. Further, projections are likely to be more accurate in the short-term than in later time periods, as trends are more likely to change over longer periods of time. The decreasing reliability of cancer predictions over time is also related to the decreasing reliability of the population predictions. Specifically, changes to the population are cumulative, causing a decrease in the reliability of the predicted numbers over time.

Another limitation in the projections comes from the small size of Manitoba's population. In particular, projections were limited to those sites with enough cases to satisfy the requirements of the prediction model (a minimum of three age groups with at least 20 cases per calendar period and age group). All other sites were combined into one category called "Other," and hence individual trends for these sites were not projected. Despite this, for those cancer sites with sufficient numbers, the patterns in the projected age-standardized rates were generally consistent with other published predictions.[5]

**FIGURE 3**
**Actual and projected population of Manitoba by age and sex: 2003[a] and 2023[b]**




Source: Manitoba Bureau of Statistics, Manitoba Population Projections 2006 to 2026, December 2006
Notes: a. 2003 refers to average annual population as recorded 2001 - 2005.
b. 2023 refers to average annual population as predicted 2021 - 2025.

## Conclusion

This study demonstrates that cancer projections can be used as a benchmark against which to estimate the impact of cancer prevention initiatives. Total age-standardized incidence for cancer in Manitoba is expected to decrease slightly over the next 20 years, with reduction in tobacco use likely being the largest attributable factor. The introduction of new and effective prevention measures may be necessary to increase this downward trend. This study also provides useful information for planning for future provision of cancer services in Manitoba based on the expected increase in the number of people diagnosed with cancer as the population of the province grows.

## References


1. Bray F, Moller B. Predicting the future burden of cancer. Nat Rev Cancer. 2006;6:63-74.
2. Clements MS, Armstrong BK, Moolgavkar SH. Lung cancer rate predictions using generalized additive models. Biostatistics. 2005;6:576-89.
3. de Vries E, van de Poll-Franse LV, Louwman WJ, de Gruijl FR, Coebergh JW. Predictions of skin cancer incidence in the Netherlands up to 2015. Br J Dermatol. 2005;152:481-8.
4. Moller B, Fekjaer H, Hakulinen T, Tryggvadottir L, Storm HH, Talback M, Haldorsen T. Prediction of cancer incidence in the Nordic countries up to the year 2020. Eur J Cancer Prev. 2002;11 Suppl 1:S1-S96.
5. Moller H, Fairley L, Coupland V, Okello C, Green M, Forman D, Moller B, Bray F. The future burden of cancer in England: incidence and numbers of new patients in 2020. Br J Cancer. 2007;96:1484-8.
6. New Zealand Ministry of Health. Cancer in New Zealand: trends and projections [Internet]. Ministry of Health (NZ); 2002 Nov [cited 2010 Jun 9]. Available from: http://www.moh.govt.nz/moh.nsf/0/8e1d731682cab3d9cc256c7e00764a23?
7. Smith BD, Smith GL, Hurria A, Hortobagyi GN, Buchholz TA. Future of cancer incidence in the United States: burdens upon an aging, changing nation. J Clin Oncol. 2009;27:2758-65.
8. Moller B, Fekjaer H, Hakulinen T, Sigvaldason H, Storm HH, Talback M, Haldorsen T. Prediction of cancer incidence in the Nordic countries: empirical comparison of different approaches. Stat Med. 2003;22(17):2751-66.
9. Stewart P, Xie L. Results of survey on cancer projection methods used in the provincial/territorial cancer registries. Presented at: Canadian Cancer Statistics Steering Committee Meeting; June 23, 2009; Toronto, ON.
10. World Health Organization. Manual of the international statistical classification of diseases, injuries and causes of death. 9th rev. Geneva: World Health Organization; 1977.
11. World Health Organization. International classification of diseases [Internet]. Geneva: WHO; 2010 [cited 2010 Feb 10]. Available from: http://www.who.int/classifications/icd/en/
12. Manitoba Bureau of Statistics. Manitoba Population Projections 2006 to 2026. Winnipeg (MB): Manitoba Bureau of Statistics; 2006 Dec.
13. Osmond C. Using age, period and cohort models to estimate future mortality rates. Int J Epidemiol. 1985;14(1):124-9.
14. Clayton D, Schifflers E. Models for temporal variation in cancer rates. II: Age-period-cohort models. Stat Med. 1987;6(4):469-81.
15. Moller B, Aagnes B. Predictions of cancer incidence by health region 2010-2020. In: Cancer in Norway 2005: cancer incidence, mortality, survival and prevalence in Norway [Internet]. Oslo: Cancer Registry of Norway, 2006 [cited 2010 Jun 9]. Available from: http://www.kreftregisteret.no/en/General/Publications/Cancer-in-Norway/Cancer-in-Norway-2005/
16. H. Krueger & Associates Inc. An overview of selected cancers and the modifiable cancer risk factors in Canada. Toronto (ON): The Primary Prevention Action Group of the Canadian Partnership Against Cancer; 2008 May.

17. H. Krueger & Associates Inc. Making the Case for Primary Prevention: An Economic Analysis of Risk Factors in Manitoba. Winnipeg (MB): The Heart and Stroke Foundation of Manitoba. 2010 Sept.

18. Rehm J, Baliunas D, Brochu S, Fischer B, Gnam W, Patra J, Popova S, Sarnocinska-Hart A, Taylor B, Adlaf E, Recel M, Single E. The costs of substance abuse in Canada 2002 [Internet]. Ottawa (ON): Canadian Centre on Substance Abuse. 2006 Mar [cited 2010 Feb 2]. Available from: http://www.ccsa.ca/Eng/Priorities/Research/CostStudy/Pages/default.aspx

# Dietary sodium intake among Canadian adults with and without hypertension

*Y. Shi, PhD; M. de Groh, PhD; H. Morrison, PhD; C. Robinson, MA; L. Vardy, BA*

## Abstract

**Introduction**: Almost 30% of hypertension among Canadians may be attributed to excess dietary sodium.

**Methods**: We examined the average sodium intake of Canadians aged 30 years and over, with and without hypertension, by age, sex and diabetes status using 24-hour recall data from the 2004 Canadian Community Health Survey, Cycle 2.2, Nutrition. We compared absolute (crude) average sodium intake levels of those with and without hypertension to the 2009 Canadian Hypertension Education Program (CHEP) guidelines and adjusted average sodium intake between those with and without hypertension.

**Results**: Both those with and without diagnosed hypertension display average sodium intakes well above the 1500 mg/day recommended by the 2009 CHEP guidelines (2950 mg/day and 3175 mg/day, respectively). After confounding adjustment, those with hypertension have significantly higher average sodium intake ($p$ = .0124). Stratified subgroup analyses found the average sodium intake among those with hypertension was higher for men between 30 and 49 years old ($p$ = .0265), women between 50 and 69 years old ($p$ = .0083) and those without diabetes ($p$ = .0071) when compared to their counterparts without hypertension.

**Conclusion**: Better approaches are needed to reduce sodium intake in hypertension patients, as well as the general population.

***Keywords:*** *sodium intake, salt intake, hypertension, high blood pressure, Canadian Hypertension Education Program, CHEP guidelines*

## Introduction

Hypertension is one of the most important risk factors for heart diseases and stroke, two of the leading causes of death and hospitalization in Canada. An estimated 19% of Canadian adults aged 20 to 79 years are hypertensive, and an estimated 90% of the population will develop hypertension over their lifetime.[1,2] Almost 30% of hypertension among Canadians may be attributed to excess dietary sodium.[3] A dose-response relationship between sodium intake and elevated blood pressure has been repeatedly demonstrated in epidemiological studies.[4-6] Restricting dietary sodium intake lowers blood pressure among individuals with and without hypertension, with larger effects in reducing blood pressure in people with hypertension.[7,8] Sustained reduction in dietary sodium is associated with favourable cardiovascular outcomes, such as reduced cardiovascular events.[9]

The updated 2009 Canadian Hypertension Education Program (CHEP) guidelines for the management of hypertension recommend restricting dietary sodium to 1500 mg/day and not exceeding 2300 mg/day, in addition to eating a well-balanced diet.[10] These sodium intake thresholds are based on the nutrient reference values developed by the Institute of Medicine in 2004, with 1500 mg/day regarded as the Adequate Intake Level (AI) for healthy adults and 2300 mg/day the Tolerable Upper Intake Level (UL) for adults.[11] Intake above this UL may increase the risk of adverse health effects, though the report summarizes studies that have documented a clear dose response between sodium intake and blood pressure below this UL level.[11]

Despite published clinical guidelines and increased public health messages on limiting dietary sodium, a recent report from Statistics Canada reveals high average intake levels of sodium for Canadians of all ages.[12] While reducing sodium intake is important for everyone, it may be particularly critical for those with hypertension.

Are people with hypertension more likely to receive advice from their physicians concerning lifestyle changes, particularly reducing dietary sodium? As a result, do they reduce their sodium intake or, at the very least, not increase their sodium intake after learning they have hypertension? While it is feasible for people with hypertension to achieve and maintain a low salt diet over the long-term, the process is challenging and requires comprehensive steps to be successful.[13] To understand how much sodium is consumed by people with hypertension, we examined and compared average daily sodium intake between people with hypertension and without, after controlling for key potential confounding factors.

## Methods

### *Sample*

Data on individual daily sodium intake were collected using a 24-hour dietary recall interview that was conducted as part of the Canadian Community Health Survey

**Author references:**

Center for Chronic Disease Prevention and Control, Public Health Agency of Canada, Ottawa, ON, Canada

**Correspondence:** Dr. Yipu Shi, Science Integration Division, Center for Chronic Disease Prevention and Control, Public Health Agency of Canada, 7th Floor, 785 Carling Avenue, Ottawa, Ontario, Canada K1A 0K9; Tel.: (613) 957-8584; Fax: (613) 941-2633; Email: yipu.shi@phac-aspc.gc.ca

(CCHS), Cycle 2.2, Nutrition (2004).[14] The CCHS 2.2 targeted people of all ages living in private dwellings in the 10 provinces, but excluded full-time members of the Canadian forces, and those in the 3 territories, reserves, institutions and remote areas. As such, it represented approximately 98% of the population in the ten provinces. The overall response rate for the CCHS 2.2, Nutrition (2004) was 76.5%. Statistics Canada and Health Canada have published detailed descriptions of the CCHS design, sampling and interview procedures.[14,15] Briefly, a total of 35 107 people completed an initial recall interview on all foods and beverages consumed from midnight to midnight before the interview. A five-step method based on the Automated Multiple-Pass Method developed by the US Department of Agriculture was used to optimize data collection.[16] The nutrient values in Canadian foods came from the Canadian Nutrient File (CNF), a comprehensive, computerized bilingual database containing up to 143 nutrients in over 5500 foods, including foods that are unique to Canada.[17] Only respondents aged 30 and older were included in our study.

### *Variables*

Chronic conditions in the CCHS are self-reported and defined as "long-term conditions that are expected to last or have already lasted for 6 months or more and that have been diagnosed by a health professional." To determine hypertension status, participants were asked if they had "high blood pressure." Those with a response other than "yes" or "no" to this question were excluded from our analyses. Other variables included in the analyses were age, sex, body mass index (BMI), household education and income, smoking status, leisure time physical activity, diabetes status and total daily energy intake.

We established three age categories for this study: 30 to 49, 50 to 69, and 70 years and older. BMI was also categorized into three groups: under or normal weight (BMI < 25.0 kg/m$^2$), overweight (25 kg/m$^2$ ≤ BMI < 30.0 kg/m$^2$) and obese (BMI ≥ 30.0 kg/m$^2$). Total energy intake was the sum of all energy intakes from food sources in a single day in kilocalories (kcal).[17]

To define household education, we used the highest level of education among adult members of the household and set up the following four categories: less than secondary graduation, secondary graduation, some postsecondary education and postsecondary graduation. Dividing the total income for the household from all sources in the 12 months prior to the interview by the number of people living in the household, we established four income categories: low income, lower-middle income, upper-middle income and high income.[15] Due to a considerable number of no responses to the income question, a fifth income category (missing) was also created.

We defined three smoking status categories: current daily smokers (those who smoked cigarettes daily at the time of the interview and who had smoked 100 cigarettes or more over their lifetime); former smokers (those who had smoked daily but quit or still smoked occasionally at the time of the interview) and non-smokers (those who had never smoked or had smoked fewer than 100 cigarettes in their lifetime). Similarly, we categorized respondents into three physical activity groups based on their level of physical activity (frequency, duration and intensity) during leisure time over the previous 3 months: inactive, moderately active and physically active.[15]

Diabetes status was determined by whether or not a respondent reported a diagnosis of diabetes by a health professional.

### *Analyses*

Our analyses were restricted to adults aged 30 and over, with a valid 24-hour dietary recall (n = 15 232). Of those, we eliminated 189 participants whose daily total energy intake was less than 500 kcal, another 21 who were missing hypertension status, and a further 6155 who did not have their weight and height measured (to calculate BMI), leaving a total of 8867 respondents in our analyses. We compared the baseline characteristics of respondents in terms of their self-reported hypertension status, including daily total energy intake, age, sex, BMI, leisure time physical activity, household education and income, smoking and diabetes status. We calculated average daily intake of sodium for those with and without hypertension, and estimated 95% confidence intervals (CI) for means using the bootstrap method to account for the complex multistage survey design. We determined statistical significance by comparing the 95% confidence intervals (CIs) for the means and compared average (crude) estimates of sodium intake for specific groups to the 2009 CHEP guidelines.[10]

We compared the average intake of sodium for people with and without hypertension using multivariate linear regression in order to account for extraneous differences in age, sex, BMI, total daily energy intake, household income and education, smoking, physical activity and the presence of diabetes between the two groups. We log-transformed daily sodium intake and energy intake to achieve the normal distribution required for statistical analyses and calculated adjusted sodium intake averages using marginal means and β coefficients from the multivariate linear regression equations. We determined statistical significance from the bootstrap method results. Moreover, we carried out stratified analyses by age and gender, and compared differences in mean sodium intake (unadjusted and adjusted) between hypertension and non-hypertension groups.

## Results

Of the 8867 Canadians aged 30 years and over in the study, 2455 report having hypertension diagnosed by a health care professional—19% after applying appropriate survey weights. They are more likely to be older, obese, less educated, and a former daily smoker and have lower family income and diagnosed diabetes as a co-morbid chronic condition. (Table 1)

The unadjusted average daily intake of sodium is 2950 mg (95% CI: 2810–3090) for those with hypertension and 3175 mg (95% CI: 3078–3273) for those without (Table 2). The unadjusted mean sodium intake estimates for hypertensive and non-hypertensives of various age, sex and diabetes status groups are all well above the 2300 mg/day maximum set by the 2009 CHEP guidelines.[10]

**TABLE 1**
**Baseline characteristics of participants (aged 30 and older) with or without hypertension.**

| | Hypertensive (95% CI) | | Non-hypertensive (95% CI) | |
|---|---|---|---|---|
| Sample size (n) | 2455 | | 6412 | |
| Weighted sample (n) | 3 415 831 | | 14 998 862 | |
| Mean energy intake (kcal) | 1870 | (1809 – 1931)* | 2140 | (2089 – 2190) |
| Mean age (years) | 63.6 | (62.7 – 64.5)* | 49.4 | (49.1 – 49.8) |
| Male (%) | 48.8 | (45.4 – 52.3) | 49.0 | (48.2 – 49.8) |
| Mean BMI (kg/m²) | 29.6 | (29.1 – 30.1)* | 27.0 | (26.8 – 27.3) |
| Age group (%) | | | | |
| 30–49 years | 14.4 | (11.2 – 7.6)* | 58.2 | (57.1 – 59.3) |
| 50–69 years | 49.4 | (45.9 – 52.9)* | 32.3 | (31.1 – 33.4) |
| 70+ years | 36.3 | (33.3 – 39.2)* | 9.6 | (9.0 – 10.1) |
| BMI (%) | | | | |
| < 25 kg/m² | 21.8 | (18.4 – 25.1)* | 39.1 | (36.7 – 41.4) |
| Between 25 kg/m² and < 30 kg/m² | 37.2 | (33.6 – 40.8) | 38.8 | (36.5 – 41.1) |
| ≥ 30 kg/m² | 41.0 | (37.2 – 44.9)* | 22.5 | (20.2 – 24.1) |
| Smoking (%) | | | | |
| Current daily smokers | 18.8 | (15.7 – 21.9)* | 25.6 | (23.5 – 27.8) |
| Former smokers | 38.1 | (34.5 – 41.6)* | 30.2 | (28.0 – 32.4) |
| Non-smokers | 43.1 | (39.3 – 47.0) | 44.1 | (41.6 – 46.5) |
| Leisure activity (%) | | | | |
| Active | 14.6 | (11.9 – 17.3) | 17.3 | (15.4 – 19.1) |
| Moderately active | 21.6 | (18.6 – 24.7) | 24.3 | (22.3 – 26.3) |
| Inactive | 63.8 | (60.2 – 67.4) | 58.5 | (56.1 – 60.9) |
| Education (%) | | | | |
| Less than secondary graduation | 32.6 | (29.4 – 35.7)* | 18.2 | (16.6 – 19.9) |
| Secondary graduation | 18.2 | (15.0 – 21.4) | 18.5 | (16.4 – 20.5) |
| Some post-secondary education | 5.0 | (3.6 – 6.3) | 6.2 | (5.1 – 7.3) |
| Post-secondary graduation | 43.4 | (40.0 – 47.0)* | 56.0 | (53.5 – 58.6) |
| Income (%) | | | | |
| Low | 12.2 | (9.4 – 15.1)* | 7.3 | (6.0 – 8.5) |
| Lower middle | 24.9 | (21.4 – 28.5)* | 18.2 | (16.4 – 20.0) |
| Upper middle | 32.3 | (28.7 – 36.0) | 33.3 | (31.0 – 35.6) |
| High | 22.8 | (19.2 – 26.4)* | 34.1 | (31.6 – 36.7) |
| Missing | 7.7 | (5.8 – 9.6) | 7.2 | (5.9 – 8.4) |
| Diabetes (Yes, %) | 16.6 | (14.2 – 19.0)* | 3.7 | (2.8 – 4.6) |

**Data source:** Canadian Community Health Survey, Cycle 2.2, Nutrition (2004). [14]
**Abbreviations:** BMI, body mass index; CI, confidence interval; *p*, statistical significance.
*$p < .05$

**TABLE 2**
**Mean sodium intake (mg/day), crude and adjusted by multivariate linear regression among people with or without hypertension (aged 30 and older) and by age, sex and diabetes status.**

| | Hypertensive (95% CI) | Non-hypertensive (95% CI) | β coefficient | Standard error | *p*-value |
|---|---|---|---|---|---|
| All (30+ years) (n) | 2455 | 6412 | | | |
| Mean sodium intake (mg/day) | 2950 (2810–3090) | 3175 (3078–3273) | | | |
| Adjusted mean sodium intake (mg/day) | 2877 | 2723 | 0.024 | 0.0094 | .0124 |
| Sex | | | | | |
| Male (n) | 878 | 2812 | | | |
| Mean sodium intake (mg/day) | 3349 (3099–3599) | 3580 (3432–3728) | | | |
| Adjusted mean sodium intake (mg/day) | 3162 | 2972 | 0.027 | 0.0133 | .0429 |
| Female (n) | 1577 | 3600 | | | |
| Mean sodium intake (mg/day) | 2570 (2458–2682) | 2787 (2677–2897) | | | |
| Adjusted mean sodium intake (mg/day) | 2655 | 2512 | 0.024 | 0.0144 | .0975 |
| Age | | | | | |
| 30–49 years (n) | 244 | 2761 | | | |
| Mean sodium intake (mg/day) | 3676 (3001–4351) | 3290 (3147–3433) | | | |
| Adjusted mean sodium intake (mg/day) | 3258 | 2911 | 0.049 | 0.0279 | .0815 |
| 50–69 years (n) | 1041 | 2404 | | | |
| Mean sodium intake (mg/day) | 3064 (2910–3219) | 3052 (2931–3172) | | | |
| Adjusted mean sodium intake (mg/day) | 2799 | 2612 | 0.03 | 0.0124 | .0176 |
| 70+ years (n) | 1170 | 1247 | | | |
| Mean sodium intake (mg/day) | 2451 (2338–2563) | 2666 (2500–2832) | | | |
| Adjusted mean sodium intake (mg/day) | 2415 | 2466 | −0.009 | 0.0117 | .4413 |
| Diabetes | | | | | |
| Yes (n) | 464 | 322 | | | |
| Mean sodium intake (mg/day) | 2767 (2541–2992) | 2915 (2644–3185) | | | |
| Adjusted mean sodium intake (mg/day) | 2449 | 2500 | −0.009 | 0.0193 | .6326 |
| No (n) | 1989 | 6090 | | | |
| Mean sodium intake (mg/day) | 2987 (2827–3147) | 3185 (3085–3286) | | | |
| Adjusted mean sodium intake (mg/day) | 2805 | 2636 | 0.027 | 0.0102 | .0071 |

**Data source:** Canadian Community Health Survey, Cycle 2.2, Nutrition (2004).[14]
**Abbreviations:** CI, confidence interval; *p*, statistical significance.
**Adjusted mean:** estimated marginal mean using multivariate linear regression.

**TABLE 3**

**Mean sodium intake (mg/day), crude and adjusted by multivariate linear regression among people with and without hypertension (aged 30 and older) for men and women, by age group.**

| | Hypertensive (95% CI) | Non-hypertensive (95% CI) | β coefficient | Standard error | *p*-value |
|---|---|---|---|---|---|
| **Male** | | | | | |
| Age 30 to 49 (n) | 120 | 1282 | | | |
| Mean sodium intake (mg/day) | 4223 (3250–5195) | 3699 (3485–3913) | | | |
| Adjusted mean sodium intake (mg/day) | 3855 | 3250 | 0.074 | 0.0335 | .0265 |
| Age 50 to 69 (n) | 402 | 1038 | | | |
| Mean sodium intake (mg/day) | 3384 (3121–3647) | 3505 (3282–3727) | | | |
| Adjusted mean sodium intake (mg/day) | 2844 | 2767 | 0.012 | 0.0169 | .4834 |
| Age 70+ (n) | 356 | 492 | | | |
| Mean sodium intake (mg/day) | 2716 (2516–2916) | 2922 (2733–3111) | | | |
| Adjusted mean sodium intake (mg/day) | 2729 | 2716 | 0.002 | 0.018 | .924 |
| **Female** | | | | | |
| Age 30 to 49 (n) | 124 | 1479 | | | |
| Mean sodium intake (mg/day) | 2810 (2338–3281) | 2886 (2729–3043) | | | |
| Adjusted mean sodium intake (mg/day) | 2965 | 2723 | 0.037 | 0.0509 | .4646 |
| Age 50 to 69 (n) | 639 | 1366 | | | |
| Mean sodium intake (mg/day) | 2753 (2585–2920) | 2694 (2531–2857) | | | |
| Adjusted mean sodium intake (mg/day) | 2698 | 2410 | 0.049 | 0.0186 | .0083 |
| Age 70+ (n) | 814 | 755 | | | |
| Mean sodium intake (mg/day) | 2256 (2151–2361) | 2477 (2238–2716) | | | |
| Adjusted mean sodium intake (mg/day) | 2143 | 2218 | −0.015 | 0.014 | .2695 |

**Data source:** Canadian Community Health Survey, Cycle 2.2, Nutrition (2004).[14]

**Abbreviations:** CI, confidence interval; n, sub-sample size; *p*, statistical significance.

**Adjusted mean:** estimated marginal mean using multivariate linear regression.

The average sodium intake for those with hypertension was then compared to those without hypertension, after adjusting for the differences in total energy intake and other confounding variables. Adjusted mean sodium intakes are significantly higher for people with hypertension than those without hypertension ($p$ = .01) (Table 2). After adjusting for potential confounders, results also indicate that men with hypertension report a significantly higher average sodium intake than men without ($p$ = .04), and that, while women with hypertension also report a higher average sodium intake than those without, the difference is not statistically significant. However, men and women aged 50 to 69 years with hypertension have a significantly higher mean sodium intake, compared to those of the same age without hypertension ($p$ = .02). A similar difference between those with and without hypertension is suggested for those aged 30 to 49, but this is not statistically significant ($p$ = .08). Among those 70 years and over, however, there is no difference in average sodium intake between those with and without hypertension.

For those without diabetes, sodium intake is considerably higher among those with hypertension compared to those without hypertension ($p$ = .007) (Table2). However, among those with diabetes, average sodium intake is lower, though there is no statistically significant difference in average sodium intake between those with and without hypertension (Table 2).

Finally, we explored possible interactions between age groups and hypertension status for men and women separately (Table 3). After adjusting for potential confounders, only young men aged 30 to 49 with hypertension have significantly higher sodium intake than men of the same age without hypertension ($p$ = .03). For women, only those age 50 to 69 with hypertension have significantly higher average sodium intake compared to women the same age without hypertension ($p$ = .008).

## Discussion

The risk of developing hypertension can be attributed to a number of component causes, such as age, family history, race/ethnicity, sodium intake, BMI, alcohol consumption, physical activity and diet.[18] Epidemiological studies have also consistently demonstrated the association between dietary sodium intake levels and the development of hypertension.[4-6] While adequate sodium is needed for the human body to regulate fluids and blood pressure and to keep muscles and nerves running smoothly, a healthy individual may need as little as 230 mg of sodium per day to maintain their sodium balance.[19] Hypertension is predominantly seen in developed countries where sodium is widely added to processed and restaurant food; people living in remote and isolated societies with habitually low sodium intake typically demonstrate little hypertension and little or no increase in blood pressure with aging.[20] In addition to hypertension, over-consumption of sodium is also associated with stomach cancer, left ventricle hypertrophy, obesity, and possibly with osteoporosis.[21-25]

As in previous reports summarizing CCHS 2.2, Nutrition (2004), our results show that Canadian adults 30 years and over are consuming levels of sodium above the UL. Our findings further demonstrate that average sodium intake is high in Canadian adults both with and without hypertension, with averages more than double the level considered adequate (i.e. the AI) and considerably higher than the UL. Those with diagnosed hypertension in Canada are clearly not reaching sodium reduction goals set for this sub-population by CHEP.

As a modifiable lifestyle risk factor, reducing dietary sodium is recommended in clinical guidelines for healthy people, to prevent hypertension, and for those already diagnosed with hypertension, to treat hypertension prior to any pharmaceutical interventions.[10] Canadian adults diagnosed with hypertension report adding sodium at the table and during cooking significantly less often than people without hypertension,[12] which suggests that some proportion of the population with hypertension are recommended to reduce their sodium reduction and take action to do so. However, given the cross-sectional nature of the data in our study, we were unable to determine whether persons with hypertension reduced their sodium intake and by how much. However, reducing sodium intake at the table and during cooking may not be particularly effective since, as mentioned earlier, the main source of sodium in the Canadian diet comes from processed and restaurant foods.

Our study shows that, after adjusting for potential confounders, adult Canadians with known hypertension consume higher levels of sodium than those without hypertension. Subgroup analyses further reveal varying degrees of difference in sodium intake between people with hypertension and without by gender and age. Our results identify young men (aged 30 to 49) with hypertension and mid- to old-age women (aged 50 to 69) with hypertension to have higher average sodium intake compared to their counterparts without hypertension. Our study also shows that older Canadians (aged 70 and over) with hypertension consume the same levels of sodium as those without. Although a survival effect may be playing a role in the result for the elderly, other studies report that urinary sodium reduction appears to increase with age, suggesting older individuals may generally be more health conscious and amenable to reducing their sodium use compared to younger individuals.[13,26,27] A prospective study in Finland found no significant reduction in salt intake among those with hypertension when compared to the group without hypertension after a 3-year study period,[28] suggesting that reducing sodium intake is challenging. Our results suggest that age and gender may be important factors influencing compliance with low-salt diets among people with hypertension, and that programs should be designed to reach those particularly resistant to change.

A notable finding from our study, however, was that people diagnosed with both diabetes and hypertension show no difference in adjusted average sodium intake from those with diagnosed diabetics without hypertension. In contrast, among people free of diabetes, those with hypertension had significantly higher average sodium intake compared to those without hypertension. These results are particularly interesting, given that Canadian clinical guidelines

for diabetes management recommend that elevated blood pressure be aggressively treated to achieve a target blood pressure control of less than 130/80 mmHg and that lifestyle changes be introduced that include limiting sodium intake.[29] These results suggest that sodium reduction, though challenging, may be achievable among high-risk individuals.

This study has a number of limitations. First, it is based on cross-sectional survey data which do not allow for direct assessment of lifestyle changes over time. Although we were unable to determine by how much people with hypertension reduce their sodium consumption, it is unlikely that people increase their intake after learning they have hypertension. Although the cross-sectional nature of these data does not allow us to explore the etiologic relationship of sodium intake with hypertension, we can compare current intake levels of sodium based on hypertension status reported by survey respondents. Second, information on individuals' diagnosis of hypertension, sodium consumption and other lifestyle factors was based on 24-hour dietary recall and self-reported physician diagnoses, which are subject to recall bias and misclassification. Direct measurement of all the parameters would have been optimal but also costly. Further, under-reporting of food intake is more extreme among those who are obese, compared to normal weight individuals. A higher percentage of those diagnosed with hypertension, compared to those without hypertension, were obese (41.0% vs. 22.5%, respectively). Consequently, our estimates of sodium intake in those with hypertension may be particularly conservative. Other limitations relate to undiagnosed hypertension, which is estimated to account for one-fifth of the hypertension population in Canada.[30] The misclassification of those with undiagnosed hypertension may have attenuated the difference in average sodium intake observed between groups split by hypertension status in our study. Moreover, respondents with other chronic conditions beyond hypertension and diabetes (e.g. heart and kidney disease) also require restricted sodium intake but could not be examined separately due to the limited sample size.

As our population ages, the prevalence of hypertension is expected to rise, further increasing the need for public health efforts to address it. Because most of the modifiable risk factors for hypertension pertain to western lifestyle characteristics, public health campaigns and clinical practice should emphasize healthy lifestyle changes, such as attaining and maintaining a healthy weight, reducing sodium intake, limiting alcohol consumption and increased physical activity. In Canada, steps are being taken to reduce dietary sodium intake in the general population. In 2007, the federal government established a multi-stakeholder working group to oversee the development and implementation of a comprehensive sodium reduction strategy.[31] Recommendations of this Sodium Working Group were released in July 2010 with specific recommendations in four areas, including voluntary reduction of sodium levels in the food supply; increased awareness and education about sodium, its adverse health effects and the ways to reduce its consumption; support for research to facilitate reformulation of processed foods; and the comprehensive monitoring of sodium intake in Canada and overall evaluation of the sodium reduction strategy itself.[32] In addition to public health efforts, health care professionals should emphasize the importance of lifestyle changes to prevent and manage hypertension, including the need for patients to achieve sodium reduction targets in accordance with Canadian clinical guidelines. Finally, it is also important to emphasize that although our study focussed on the sodium intake of those with hypertension, it is the quality of one's overall diet and the quantity of food consumed that determines sodium intake levels. Since roughly 70% to 80% of daily intake of sodium comes from processed foods and restaurant foods in most of the developed world, a population approach must be taken. Successful population reduction of sodium experienced in some countries suggests that an integrated, systematic approach involving cooperation among the government, the food industry, physicians and the general public will be required to achieve effective and long lasting dietary behaviour changes.[33-36]

## References


1. Wilkins K, Campbell NRC, Joffres MR, McAlister FA, Nichol M, Quach S, Johansen HL, Tremblay MS. Blood pressure in Canadian adults. Health Rep. 2010 Mar;21(1):37-46.
2. Vasan RS, Beiser A, Seshadri S, Larson MG, Kannel WB, D'Agostino RB, Levy D. Residual lifetime risk for developing hypertension in middle-aged women and men: The Framingham Heart Study. JAMA. 2002 Feb 27;287(8):1003-10.
3. Joffres MR, Campbell NR, Manns B, Tu K. Estimate of the benefits of a population-based reduction in dietary sodium additives on hypertension and its related health care costs in Canada. Can J Cardiol. 2007 May 1;23(6):437-43.
4. Intersalt Cooperative Research Group. Intersalt: an international study of electrolyte excretion and blood pressure. Results for 24 hour urinary sodium and potassium excretion. BMJ. 1988 Jul 30;297:319-28.
5. Kesteloot H, Joosens JV. Relationship of dietary sodium potassium, calcium, and magnesium with blood pressure. Belgian Interuniversity Research on Nutrition and Health. Hypertension. 1988;12(6):594-9.
6. Smith WC, Crombie IK, Tavendale RT, Gulland SK, Tunstall-Pedoe HD. Urinary electrolyte excretion, alcohol consumption, and blood pressure in the Scottish heart health study. BMJ. 1988 Jul 30;297:329-30.
7. Sacks FM, Svetkey LP, Vollmer WM, Appel LJ, Bray GA, Harsha D, Obarzanek E, Conlin PR, Miller ER 3rd, Simons-Morton DG, Karanja N, Lin PH; DASH-Sodium Collaborative Research Group. Effects on blood pressure of reduced dietary sodium and the Dietary Approaches to Stop Hypertension (DASH) diet. N Engl J Med. 2001;344:3-10.
8. Midgley JP, Matthew AG, Greenwood CMT, Logan AG. Effect of reduced dietary sodium on blood pressure: a meta-analysis of randomized controlled trials. JAMA. 1996;275:1590-7.

9. Cook NR, Cutler JA, Obarzanek E, Buring JE, Rexrode KM, Kumanyika SK, Appel LJ, Whelton PK. Long term effects of dietary sodium reduction on cardiovascular disease outcomes: observational follow-up of the trials of hypertension prevention (TOHP). BMJ. 2007 Apr 28;334(7599):885-8.

10. Khan NA, Hemmelgarn B, Herman RJ, Bell CM, Mahon JL, Leiter LA, Rabkin SW, Hill MD, Padwal R, Touyz RM, Larochelle P, Feldman RD, Schiffrin EL, Campbell NR, Moe G, Prasad R, Arnold MO, Campbell TS, Milot A, Stone JA, Jones C, Ogilvie RI, Hamet P, Fodor G, Carruthers G, Burns KD, Ruzicka M, DeChamplain J, Pylypchuk G, Petrella R, Boulanger JM, Trudeau L, Hegele RA, Woo V, McFarlane P, Vallée M, Howlett J, Bacon SL, Lindsay P, Gilbert RE, Lewanczuk RZ, Tobe S; Canadian Hypertension Education Program. The 2009 Canadian Hypertension Education Program recommendations for the management of hypertension: Part 2—therapy. Can J Cardiol. 2009 May;25(5):287-98.

11. Institute of Medicine of the National Academies. Dietary reference intakes for water, potassium, sodium, chloride and sulfate. Washington (DC): National Academies Press, 2004.

12. Garriguet D. Sodium consumption at all ages. Health Rep. 2007;18(2):47-52.

13. Luft FC, Morris CD, Weinberger MH. Compliance to a low-salt diet. Am J Clin Nutr. 1997;65(suppl):698S-703S.

14. Canadian Community Health Survey Cycle 2.2, Nutrition (2004): a guide to accessing and interpreting the data [Internet]. Ottawa (ON): Health Canada; 2006 [cited 2010 Jan 18] Available from: http://www.hc-sc.gc.ca/fn-an/alt_formats/hpfb-dgpsa/pdf/surveill/cchs-guide-escc-eng.pdf

15. Beland Y. Canadian Community Health Survey—methodological overview. Health Rep. 2002;13(3):9-14.

16. Moshfegh AJ, Rhodes DG, Baer DJ, Murayi T, Clemens JC, Rumpler WV, Paul DR, Sebastian RS, Kuczynski KJ, Ingwersen LA, Staples RC, Cleveland LE. The US Department of Agriculture Automated Multiple-Pass Method reduces bias in the collection of energy intakes. Am J Clin Nutr. 2008 Aug;88(2):324-32.

17. Canadian Nutrient File [Internet]. Ottawa (ON): Health Canada. 2007 [cited 2010 Jan 18]. Available from: http://www.hc-sc.gc.ca/fn-an/nutrition/fiche-nutri-data/index-eng.php

18. Chobanian AV, Bakris GL, Black HR, Cushman WC, Green LA, Izzo JL Jr, Jones DW, Materson BJ, Oparil S, Wright JT Jr, Roccella EJ; Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure. National Heart, Lung, and Blood Institute; National High Blood Pressure Education Program Coordinating Committee. The seventh report of the Joint National Committee on the Prevention, Detection, Evaluation and Treatment of High Blood Pressure. Hypertension. 2003;42:1206-52.

19. National High Blood Pressure Education Program Working Group report on primary prevention of hypertension. Arch Intern Med. 1993;153:186-208.

20. Poulter NR, Khaw KT, Mugambi M, Peart WS, Sever PS. Migration-induced changes in blood pressure: a controlled longitudinal study. Clin Exp Pharmacol Physiol. 1985;12(3):211-216.

21. Wang XQ, Terry PD, Yan H. Review of salt consumption and stomach cancer risk: epidemiological and biological evidence. World J Gastroenterol. 2009 May 14;15(18):2204-13.

22. du Cailar G, Ribstein J, Mimran A. Dietary sodium and target organ damage in essential hypertension. Am J Hypertens. 2002;15:222-9.

23. Antonios TF, MacGregor GA. Deleterious effects of salt intake other than effects on blood pressure. Clin Exp Pharmacol Physiol. 1995 Mar;22(3):180-4.

24. Hoffmann IS, Cubeddu LX. Salt and the metabolic syndrome. Nutr Metab Cardiovasc Dis. 2009 Feb;19(2):123-8.

25. Tuomilehto J, Jousilahti P, Rastenyte D, Moltchanov V, Tanskanen A, Pietinen P, Nissinen A. Urinary sodium excretion and cardiovascular mortality in Finland: a prospective study. Lancet. 2001 Mar 17;357(9259):848-51.

26. Tschann JM, Adamson TE, Coates TJ, Gullion DS. Behaviors of treated hypertensive patients and patient demographic characteristics. J Community health. 1988 Spring;13(1):19-32.

27. Rothman KJ, Greenland S, Lash TL. Modern Epidemiology, 3rd ed. Philadelphia (PA): Lippincott Williams & Wilkins; 2008.

28. Pietinen P, Tanskanen A, Nissinen A, Tuomilehto J, Puska P. Changes in dietary habits and knowledge concerning salt during a community-based prevention program for hypertension. Ann Clin Res. 1984;16(Suppl 43):151-5.

29. Canadian Diabetes Association. 2008 clinical practice guidelines for the prevention and management of diabetes in Canada [Internet]. Can J Diabetes. 2008 Sep [cited 2010 Jan 18];32(Suppl 1). Available from: http://www.diabetes.ca/for-professionals/resources/2008-cpg/

30. Leenen FH, Dumais J, McInnis NH, Turton P, Stratychuk L, Nemeth K, Lum-Kwong MM, Fodor G. Results of the Ontario survey on the prevalence and control of hypertension. CMAJ. 2008 May 20;178(11):1441-9.

31. The issue of sodium [Internet]. Ottawa (ON): Health Canada; 2010 [cited 2009 Dec 23]. Available from: http://www.hc-sc.gc.ca/fn-an/nutrition/sodium/issue-question-sodium-eng.php

32. Sodium Working Group. Sodium reduction strategy for Canada: recommendations of the Sodium Working Group [Internet]. Ottawa (ON): Health Canada; 2010 July [cited 2010 Sep 2]. Available from: http://www.hc-sc.gc.ca/fn-an/nutrition/sodium/strateg/index-eng.php

33. Dickinson BD, Havas S; Council on Science and Public Health. Reducing the population burden of cardiovascular disease by reducing sodium intake: a report of the Council on Science and Public Health. Arch Intern Med. 2007 Jul 23;167(14):1460-8.

34. Karppanen H, Mervaala E. Sodium intake and hypertension. Prog Cardiovasc Dis. 2006 Sep-Oct;49(2):59-75.

35. Pekka P, Pirjo P, Ulla U. Influencing public nutrition for non-communicable disease prevention: from community intervention to national programme-experiences from Finland. Public Health Nutr. 2002 Feb;5(1A):245-51.

36. Food Standards Agency. Salt reduction targets [Internet]. The National Archives, England: 2009 May 18 [cited 2010 Sep 2]. Available from: http://www.food.gov.uk/healthiereating/salt/saltreduction

# CSEB Student Conference 2010 abstract winners

At the May 2010 Canadian Society for Epidemiology and Biostatistics (CSEB) Student Conference, *Chronic Diseases in Canada (CDIC)* announced a student abstract contest: an editorial panel from the Public Health Agency would judge the chronic disease abstracts put forward from this conference and select the top 10 to be published in this, the March 2011, issue of the journal.

Students showed great interest in this contest: 57 abstracts on chronic diseases and injuries were submitted to the journal. The editorial panel of judges comprised:

- Howard Morrison, PhD, Editor-in-Chief, *Chronic Diseases in Canada*, Public Health Agency of Canada;
- Kenneth Johnson, PhD, Senior Epidemiologist, Public Health Agency of Canada;
- Fabiola Tatone-Tokuda, MSc, Editorial Board, *Chronic Diseases in Canada*, University of Ottawa;
- Michelle Tracy, MA, Managing Editor, *Chronic Diseases in Canada*, Public Health Agency of Canada.

The abstracts were judged using the following criteria: (1) originality; (2) clarity; (3) scientific and technical excellence; and (4) potential impact.

Since 2009, *CDIC* has been collaborating with CSEB to foster publishing opportunities for students. Following the May 2009 CSEB Student Conference, CDIC agreed to publish all of the accepted abstracts at the conference in conjunction with the *Canada Communicable Disease Report*. These abstracts can be viewed online at http://www.phac-aspc.gc.ca/publicat/cdic-mcc/30-2/cseb_01-eng.php for chronic disease and injury topics, and http://www.phac-aspc.gc.ca/publicat/cdic-mcc/abstract/index-eng.php for infectious disease topics.

*CDIC* is pleased to encourage students in their publishing efforts. Congratulations to the winners!

**Michelle Tracy, MA**
Managing Editor, *Chronic Diseases in Canada*

# Using childhood Leg Length Index to predict development of adolescent overweight and obesity

*Akseer N. (1); Liu J. (2); Hay J. (3); Faught B. (4); Wade T. (4); Cairney J. (4)*

**Background / Purpose / Objectives:** The increasing prevalence of overweight and obesity (OwOb) in pediatric populations is becoming a public health concern in many countries. Our purpose was to determine if childhood stature components, particularly the Leg Length Index (LLI = [overall height – sitting height]/ height), are useful in assessing risk of OwOb in adolescence.

**Study design / Methods:** Approximately 2360 Niagara Region students had their bodies measured to include sitting and standing height at baseline. Of these, 1167 children (573 girls, 594 boys) had their weight and height measured at the 5th year follow-up. OwOb was defined using age- and sex-specific body mass index (BMI; $kg/m^2$) with cut-off points corresponding to adults' BMI > 25.

**Results:** Overall, 34% (n = 298) of adolescents were considered as OwOb. The results from logistic regression analysis indicate that with 1 unit increase in LLI, odds of OwOb decreases 24% (OR = 0.76, 95% CI: 0.66–0.87) after adjusting for age, sex and baseline waist circumference. Further adjusting for early life confounders does not change the relationship.

**Conclusions:** LLI measured at childhood can be used to predict the OwOb risk in adolescents. However, the underlying mechanism is unclear and further study is needed. Mother's BMI and smoking status can modify childhood LLI.

# Characteristics associated with unmet support needs in families of school-aged children with an autism spectrum disorder

*Brown H.K. (5); Ouellette-Kuntz H. (5); Hunter D. (5); Kelley E. (6)*

**Background / Purpose / Objectives:** Due to the recognized strain on autism services, the objectives of this study were (1) to describe unmet support needs reported by parents of school-aged children with an autism spectrum disorder and (2) to examine these needs in relation to the child's functional independence. We hypothesized that families of children with low or high functional independence would have a greater unmet support needs than families of children with moderate functional independence.

**Study design / Methods:** We conducted a cross-sectional survey of 77 families of children with an autism spectrum disorder using the Family Needs Questionnaire and the Scales of Independent Behaviour—Revised. Children's functional independence was determined by their adaptive skills and problem behaviours. Their average age was 9.6 years (SD = 2.1), and 85.7% were male.

**Results:** Generalized linear modelling showed that, after controlling for other variables, differences in unmet needs between children with low versus moderate functional independence were not significant (RR = 1.27, 95% CI: 0.67–2.38). Contrary to our hypothesis, children with high functional independence had a significantly lower risk for unmet needs compared to those with moderate functional independence (RR = 0.61, 95% CI: 0.43–0.85).

**Conclusions:** Information about unmet needs may help policy makers and service providers effectively allocate limited resources.

Author references

1. Faculty of Applied Health Sciences, Brock University, St. Catharines, Ontario, Canada
2. Department of Community Health Sciences, Brock University, St. Catharines, Ontario, Canada
3. Department of Psychiatry and Behavioural Neurosciences, McMaster University, Hamilton, Ontario, Canada
4. Department of Family Medicine, McMaster University, Hamilton, Ontario, Canada
5. Department of Community Health and Epidemiology, Queen's University; Kingston, Ontario, Canada
6. Department of Psychology, Queen's University, Kingston, Ontario, Canada

# Screen time and risk behaviours in 10- to 16-year-old Canadian youth

*Carson V. (1); Pickett W. (2,3); Janssen I. (1,2)*

**Background / Purpose / Objectives:** To examine television, computer, and video game use as possible determinants of multiple risk behaviours (MRB) among Canadian youth.

**Study design / Methods:** Results were based on the Canadian 2005/06 Health Behaviour in School-Aged Children survey that included a representative cross-sectional sample of 8215 youth in grades 6 to 10, and a 1-year longitudinal sample of 1424 youth in grades 9 to 10. Participants were grouped into quartiles based on the total hours per week of television, video games, and computer use. Six risk behaviour variables (smoking, drunkenness, seatbelt use, cannabis use, illicit drug use, non-use of condoms) were combined to form an MRB score. We used ordinal and repeated measure logistic regression models to examine associations between screen time and MRB variables.

**Results:** High computer use is associated with approximately a 50% increased engagement of MRB in both samples. High television use is also associated with modestly increased engagement in MRB in the cross-sectional sample.

**Conclusions:** High computer use is the screen time activity that is most strongly associated with engagement in MRB. Future research should focus on the dose-response relationship between specific screen time activities and adolescent health in an effort to strengthen current screen time guidelines for youth.

# Prevalence and risk factors of asthma in off-reserve Canadian Aboriginal children

*Chang H.J. (4); Senthilselvan A. (4)*

**Background / Purpose / Objectives:** Asthma is a common chronic disorder among children; however, only a few studies have investigated asthma morbidity in Canadian Aboriginal children. This study aims to determine the prevalence and risk factors for ever and current asthma in this population.

**Study design / Methods:** We used data for children aged 6 to 14 years from the 2006 Aboriginal Peoples Survey. Over 15 000 children living off-reserve participated in the survey. A child was considered to have asthma if there was a parental report of asthma diagnosis by a health professional.

**Results:** Among Canadian Aboriginal children living off-reserve, the prevalence of ever and current asthma is 14.3% and 5.7 %, respectively. Children of Inuit ancestry have significantly lower prevalence of asthma than children of North American Indian and Métis ancestries. Significant risk factors for ever asthma included male sex, allergy, low birth weight, obesity, dwelling needing repairs and urban residence. The associations between ever asthma and low income family, daycare attendance and psychological problems were borderline significant. The risk factors for current asthma were similar to those for ever asthma.

**Conclusions:** The risk factors for ever asthma observed for off-reserve Aboriginal children in our study were similar to those reported for non-Aboriginal children.

Author references

1. School of Kinesiology & Health Studies, Queen's University, Kingston, Ontario, Canada
2. Department of Community Health and Epidemiology, Queen's University, Kingston, Ontario, Canada
3. Department of Emergency Medicine, Queen's University, Kingston, Ontario, Canada
4. Department of Public Health Sciences, School of Public Health, University of Alberta, Edmonton, Alberta, Canada

# Referral of acute ankle injuries for radiography in Kingston, Ontario: an evaluation of physician adherence to the Ottawa Ankle Rules

*Dowdall H. (1); Nichol M. (1); Brison R. (1,2); Pickett W. (1,2)*

**Background / Purpose / Objectives:** The Ottawa Ankle Rules were established in 1992 as evidence-based clinical decision rules for the ordering of radiography in emergency department settings. We evaluated adherence to these rules over time in two hospital-based emergency departments in Kingston, using a record linkage study.

**Study design / Methods:** In this population-based, retrospective study, we linked records of ankle injuries from Kingston sites of the Canadian Hospitals Injury Reporting and Prevention Program (2001–2007) to hospital discharge records containing procedural codes. Proportions of ankle injuries referred for radiography were described temporally, and compared with the referral rate in 1993 following implementation of the Ottawa Ankle Rules.

**Results:** Compared with a baseline referral rate of 57.6% (95% CI: 55.3–59.9) following implementation of the Ottawa Ankle Rules, analysis of 7706 acute ankle injuries shows that the proportion of ankle injuries referred for radiography has increased (e.g. 70.3 % [95% CI: 67.3–72.9] in 2007). The proportion of referrals with a diagnosis of fracture remains the same throughout the study period (18.3% to 21.9%).

**Conclusions:** Physicians need to adhere to the Ottawa Ankle Rules in order to reduce costs within the emergency department and to limit patient exposure to radiographic procedures.

# The relationship between adiposity and Gleason score in men with localized prostate cancer

*Hack E.E. (3); Siemens D.R. (4); Groome P.A. (3)*

**Background / Purpose / Objectives:** The association between adiposity and the aggressiveness of prostate cancer (PCa) is controversial. We investigated the relationship between body mass index (BMI) at the time of PCa diagnosis and malignant phenotype as measured by Gleason score.

**Study design / Methods:** In this cross-sectional study conducted on 1096 PCa patients treated for cure in Ontario, data from an electronic dataset were enhanced by retrospective chart review. BMI was categorized as normal (BMI < 25.0 kg/m$^2$), overweight (BMI: 25.0–29.9 kg/m$^2$) and obese (BMI ≥ 30 kg/m$^2$). We also investigated the role of diabetic status. We categorized Gleason scores into clinically meaningful categories, 2–4, 5–6, 7 and 8–10.

**Results:** BMI was not associated with Gleason score; 9.7% of those with normal BMI have Gleason scores greater than or equal to 8, and 9.4% in this Gleason score category are overweight or obese ($p$ = .73). Of those with diabetes, 11.7% have Gleason scores greater than or equal to 8 compared to 9.3% in the non-diabetic group ($p$ = .79). When stratified by age, the Gleason score distribution in the youngest obese cohort trended toward higher Gleason scores ($p$ = .13).

**Conclusions:** Neither elevated BMI nor diabetic status at the time of diagnosis appears to be associated with Gleason score. The effect of adiposity on PCa requires further study with attention to length of exposure to an elevated BMI.

Author references

1. Department of Community Health and Epidemiology, Queen's University, Kingston, Ontario, Canada
2. Department of Emergency Medicine, Queen's University, Kingston, Ontario, Canada
3. Division of Cancer Care and Epidemiology, Cancer Research Institute at Queen's University, Kingston, Ontario, Canada
4. Department of Urology, Queen's University, Kingston, Ontario, Canada

# Discharge against medical advice after traumatic brain injury: is intentional injury a predictor?

*Kim H. (1); Colantonio A. (2); Bayley M. (2); Dawson D. (3)*

**Background / Purpose / Objectives:** Discharges against medical advice (DAMA) are consistently reported as causing worse functional outcomes and frequent hospital readmissions. Our study aims to develop a risk profile of DAMA patients with traumatic brain injury (TBI), to examine factors associated with DAMA occurrence and to examine whether intentional injury is a significant predictor of DAMA.

**Study design / Methods:** We conducted a retrospective cohort study using hospital discharge data from the Minimal Data Set (MDS) of the Ontario Trauma Registry (OTR) for the years 1993/94 and 2000/01. The MDS review yielded 15 684 cases of TBI; 446 (2.84%) had recorded DAMA events.

**Results:** DAMA is significantly greater in those with intentional TBI compared to unintentional TBI. Patients with intentional injuries are two times more likely to leave hospital against medical advice than those with unintentional injuries controlling for other factors. Younger ages between 25–54 years and history of alcohol/drug abuse are also significantly associated with DAMA.

**Conclusions:** TBI patients who leave hospital against medical advice are a high-risk population. Intentional injury is an important independent factor to consider when modelling DAMA studies. Early identification of patients with intentional TBI could allow implementation of better preventative strategies, thus improving health outcomes and enhancing healthcare delivery.

# Rehabilitation outcomes after intentional traumatic brain injury: functional changes and discharge destinations

*Kim H. (1); Colantonio A. (2); Bayley M. (2); Dawson D. (3)*

**Background / Purpose / Objectives:** Traumatic brain injury (TBI) due to violence is a major public health issue; a recent report by the Canadian Institute for Health Information (CIHI) indicates that intentional TBI is increasing among young adults. This study aims to investigate functional changes and discharge destinations of intentional TBI patients compared to unintentional TBI patients.

**Study design / Methods:** In this prospective cohort study, we used population-based acute care and inpatient rehabilitation records, the Discharge Abstract Dataset (DAD) and the National Rehabilitation Reporting System (NRS) from the CIHI. We examined absolute and relative functional gains in motor and cognitive subscales and discharge destinations as rehabilitation outcome measures.

**Results:** People with intentional TBI have significantly lower absolute gains in motor functions and relative gains in cognitive functions in univariate analyses at discharge. Intentional TBI is also associated with lower relative gains in cognitive functions, while controlling for age, gender, alcohol/drug abuse history and other demographic and clinical variables. People with intentional TBI are less likely to be discharged home, controlling for other independent variables.

**Conclusions:** People with intentional TBI are a distinct population in the rehabilitation setting in Canada. During in-patient rehabilitation, focusing on effective changes in cognitive functions would be more applicable to this population. Different discharge destinations would also imply that more careful discharge planning should be developed.

Author references

1. Rehabilitation Science Sector, University of Toronto, Toronto, Ontario, Canada
2. Toronto Rehabilitation Institute, University of Toronto, Toronto, Ontario, Canada
3. Kunin-Lunenfeld Applied Research Unit, Baycrest, Toronto, Ontario, Canada

# General social support and work social support and the risk of recurrence after a first myocardial infarction: 6-year prospective study

*Thiam A. (1); Brisson C. (1)*

**Background / Purpose / Objectives:** This study evaluated the effect of low general social support (GSS) and low work social support (WSS) on the risk of recurrent coronary heart disease (CHD).

**Study design / Methods:** A cohort of 972 women and men who had had a first acute myocardial infarction was recruited from Quebec hospitals. Three interviews were conducted over the 6 years of follow-up and medical files were examined to identify the following CHD events: a fatal CHD, a non-fatal myocardial infarction and an unstable angina. We evaluated GSS (emotional or informational support and positive social interaction) using the French version of the medical outcomes study Social Support Survey and WSS (relationships with colleagues and supervisor) using Faucett's questionnaire, based on the Interpersonal Relationships Inventory. We used Cox regression to analyze the data.

**Results:** A total of 206 CHD events occurred during the follow-up period. There was significant moderate association between continuous exposure to low GSS and the risk of recurrent CHD (adjusted hazard ratio = 1.66, CI: 1.08–2.57). No association was observed between low WSS and risk of recurrent CHD.

**Conclusions:** Our study shows that post-myocardial patients who have little social support in their general environment (but not specifically at work) are at higher risk of recurrent CHD. We also show that there is a need for future studies on this topic.

# Prevalence and risk factors for underhousing among trans people in Ontario: a cross-sectional study

*Warner A. J. (2); Bauer G. R. (2) ; Scanlon K. (3); Pyne J. (4)*

**Background / Purpose / Objectives:** Lack of adequate housing and housing discrimination, which occurs in Canada and worldwide, negatively impacts the health and well being of those affected. Trans populations experience disproportionately high rates of homelessness, which may compromise their ability to access safe and stable housing. In this study, we calculate prevalence estimates for underhousing and potential risk factors, and construct an exploratory predictive model of identified risk factors among the trans population.

**Study design / Methods:** Data were obtained from the Trans PULSE survey, a cross-sectional, community-based survey sampling trans people living in Ontario (n = 433). We performed univariate and bivariate analyses using a logistic predictive model for underhousing weighted by probability of recruitment.

**Results:** An estimated 33.1% of Ontario trans people are underhoused. Significant risk factors from the multivariable predictive model are having a personal income less than $15,000 (odds ratio [OR] = 3.57, 95% CI: 1.18–11.11; ref: > $30,000), always being perceived by others as trans (OR = 7.14, 95% CI: 1.08–50.00; ref: never), having a high frequency of alcohol use (OR = 2.72, 95% CI: 1.03–7.19; ref: never users).

**Conclusions:** Housing discrimination may be occurring, placing trans communities at high risk for underhousing. Additional study is needed to further improve and re-evaluate services and policies to best serve trans communities.

Author references

1. URESP, Centre de recherche FRSQ du Centre hospitalier *affilié* universitaire de Québec, Québec, Canada
2. Department of Epidemiology and Biostatistics, Schulich School of Medicine & Dentistry, The University of Western Ontario, London, Ontario, Canada
3. The 519 Church Street Community Centre, Toronto, Ontario, Canada
4. Trans PULSE Project, Ontario, Canada

# CDIC: Information for authors

Chronic Diseases in Canada (CDIC) is a quarterly scientific journal focusing on the prevention and control of non-communicable diseases and injuries in Canada. Its feature articles are peer reviewed. The content of articles may include research from such fields as epidemiology, public/community health, biostatistics, the behavioural sciences, and health services or economics. CDIC endeavours to foster communication on chronic diseases and injuries among public health practitioners, epidemiologists and researchers, health policy planners and health educators. Submissions are selected based on scientific quality, public health relevance, clarity, conciseness and technical accuracy. Although CDIC is a publication of the Public Health Agency of Canada, contributions are welcomed from both the public and private sectors. Authors retain responsibility for the contents of their papers, and opinions expressed are not necessarily those of the CDIC editorial committee nor of the Public Health Agency of Canada.

## Article types

**Peer-reviewed Feature Article:** Maximum 4000 words for main text body (excluding abstract, tables, figures, references) in the form of original research, surveillance reports, meta-analyses or methodological papers.

**Status Report:** Describe ongoing national programs, studies or information systems bearing on Canadian public health (maximum 3000 words). Abstract not required.

**Workshop/Conference Report:** Summarize significant, recently held events relating to national public health (maximum 1200 words). Abstract not required.

**Cross-Canada Forum:** For authors to present or exchange information and opinions on regional or national surveillance findings, programs under development or public health policy initiatives (maximum 3000 words). Abstract not required.

**Letter to the Editor:** Comments on articles recently published in CDIC will be considered for publication (maximum 500 words). Abstract not required.

**Book/Software Review:** Usually solicited by the editors (500-1300 words), but requests to review are welcomed. Abstract not required.

## Submitting manuscripts

Submit manuscripts to the Managing Editor, Chronic Diseases in Canada, Public Health Agency of Canada, 785 Carling Avenue, Address Locator 6805B, Ottawa, Ontario K1A 0K9; email: cdic-mcc@phac-aspc.gc.ca.

Since CDIC adheres in general (section on illustrations not applicable) to the **"Uniform Requirements for Manuscripts Submitted to Biomedical Journals"** as approved by the International Committee of Medical Journal Editors, authors should refer to this document for complete details before submitting a manuscript to CDIC (see **< www.icmje.org >**).

## Checklist for submitting manuscripts

**Cover letter:** Signed by all authors, stating that all have seen and approved the final manuscript and have met the authorship criteria including a full statement regarding any prior or duplicate publication or submission for publication.

**First title page:** Concise title; full names of all authors and institutional affiliations; name, postal and email addresses, telephone and fax numbers for corresponding author; separate word counts for abstract and text.

**Second title page:** Title only; start page numbering here as page 1.

**Abstract:** Unstructured (one paragraph, no headings), maximum 175 words (100 for short reports); include 3-8 keywords (preferably from the Medical Subject Headings (MeSH) of Index Medicus).

**Text:** Double-spaced, 1 inch (25 mm) margins, 12 point font size.

**Acknowledgements:** Include disclosure of financial and material support in acknowledgements; if anyone is credited in acknowledgements with substantive scientific contributions, authors should state in the cover letter that they have obtained written permission.

**References:** In Vancouver style (consult a recent CDIC issue for examples); numbered in superscript in the order cited in text, tables and figures; listing up to six authors (first three and et al. if more); without any automatic reference numbering feature used in word processing; any unpublished observations/data or personal communications used (discouraged) to be cited in the text in parentheses (authors responsible for obtaining written permission); authors are responsible for verifying accuracy of references.

**Tables and figures:** Send vector graphics only. Each on a separate page and in electronic file(s) separate from the text (not imported into the text body); as self-explanatory and succinct as possible; not too numerous; numbered in the order that they are mentioned in the text; explanatory material for tables in footnotes, identified by lower-case superscript letters in alphabetical order; figures limited to graphs or flow charts/templates (no photographs), with software used specified and titles/footnotes on a separate page.

**Number of copies:** If submitting by mail, one complete copy, including tables and figures; one copy of any related supplementary material, and a copy of the manuscript on diskette. If submitting by email to cdic-mcc@phac-aspc.gc.ca, please fax or mail the covering letter to the address on the inside front cover.